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CONTENTS

4 May Who's Who
33 Development Methods and Standards Needs Coordinating: H. G. Lamker
34 A.F.A. Convention Points Path of Foundry Progress
44 Members Elect National Officers and Directors
48 Material Handling in Malleable Processing: N. J. Henke
53 Scientific Research and the Canadian Foundry Industry: H. H. Fairfield
56 Determination of Molten Metal Temperatures: L. C. Tate and G. Vennerholm
64 Special Refractories, Metal Melting: W. H. Henson
71 Gating Magnesium Alloy Castings, A New Technique: J. G. Mezoff and H. E. Elliott
80 Foundry Sands, Marketing Preparation: F. P. Goettman
83 Copper Addition Contaminants Effect on Mechanical Properties of Gray Cast Iron: C. H. Lorig and K. E. Rose
94 Liquid Phenolic Resins for Casting Foundry Patterns: C. R. Simmons
97 Foundry Training Course for College Graduates
100 Costs and Pricing Key Foundry Operating Factors: G. R. Targett
107 New England Sponsors Seventh Foundry Conference
108 National Winners in A.F.A. Apprentice Contest
111 New Literature
112 Foundry Personalities
114 New A.F.A. Members
117 Firm Facts
119 New Products
122 Chapter Officers
123 Chapter Activities
128 Chapter Meetings, May-June

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★ MAY WHO'S WHO ★

H. E. Elliott

H. E. Elliott is co-author, with J. G. Mezoff, of the article *Gating Magnesium Alloy Castings, A New Technique* which appears in this issue . . . Mr. Elliott's birthplace: Forest Hills, Pa. . . . Attended Carnegie Institute of Technology, Pittsburgh, Pa., and graduated with a Bachelor of Science degree in chemical engineering (1943) . . . Began his industrial career with Dow Chemical Co., Midland, Mich., as research metallurgist, following his graduation . . . Was transferred to the Bay City plant in 1946 and named foundry metallurgist . . . Has prepared papers for technical meetings . . . Holds A.F.A. and ASM memberships.

L. C. Tate

Co-author, with G. Vennerholm, of the paper *Determination of Molten Metal Temperatures,* Mr. Tate was born in Detroit . . . Attended the University of Detroit and graduated in 1917 . . . Served in the U. S. Army during World War I, entering as a sergeant and discharged as a first lieutenant . . . Began his industrial career in 1918 with Hudson Motor Car Co., Detroit, as a member of the research engineering staff . . . In 1919 joined Ford Motor Co., Dearborn, and was assigned to the laboratory of the tractor plant . . . Upon the opening of the Rouge plant he joined the metallurgical staff and analyzed the first metal drawn from the blast furnaces . . . Became assistant supervisor of heat treats at the Rouge plant and installed the first temperature control device "lier" in the, then new, glass plant . . . Assuming the task of engineer "trouble-shooter," Mr. Tate then entered the cement plant where he helped to originate a method of making cement from blast furnace slag by the wet process . . . During World War II, Mr. Tate devoted his engineering knowledge to the production of war materials . . . He began research in magnesium making processes in the manufacture of Pratt-Whitney airplane engines and remained in this occupation until the war's end . . . He is now chemical engineer of Ford Motor Company's huge open hearth mill at the Rouge plant.

C. R. Simmons

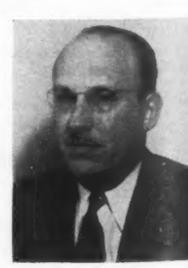
The casting of resins for foundry patterns is explained in *Liquid Phenolic Resins for Casting Foundry Patterns* . . . Mr. Simmons was born in Buffalo, N. Y. . . . A member of the 1926 graduating class, University of Michigan, Ann Arbor, he was given a Bachelor of Arts degree . . . Was attached to the sales promotion staff, Fruehauff Trailer Co., Detroit, from 1927-30 . . . The following year joined Vacuum Power Equipment Co., Detroit, as sales engineer . . . At present is performing public relations work for Durez Plastics & Chemicals, Inc., North Tonawanda, N. Y. . . . Has written on various phases of the plastics industry for the trade press.

C. H. Lorig

Clarence H. Lorig is supervisor of research in foundry metallurgy, Battelle Memorial Institute, Columbus, Ohio . . . Part-author of paper herein on *Copper Addition Contaminants Effect on Mechanical Properties of Gray Cast Iron* . . . Co-author is K. E. Rose . . . Mr. Lorig was born in St. Paul, Minn. . . . Obtained a Bachelor of Science degree in mining and metallurgy from University of Wisconsin, Madison, 1924 . . . One year later was given his Master of Science degree from the same school . . . In 1928 was awarded his Doctor of Philosophy degree . . . Entered industry in 1925 as metallurgist, Wisconsin Appleton Co., South Milwaukee . . . From 1928-29 was metallurgist with French Battery Co., Madison, and Ladish Drop Forge Co., Cudahy, Wis. . . . Was made research engineer, University of Wisconsin (1929) . . . Later in 1929 was assistant professor of mechanical engineering, Drexel Institute, Philadelphia . . . Joined the metallurgical staff, Battelle Memorial Institute, in 1930 . . . Has written widely for the trade press . . . Prepared numerous papers for technical society meetings and conventions . . . Is chairman of the A.F.A. Steel Division and a member of the A.F.A. Gray Iron Division's Advisory Group . . . Memberships include A.F.A., AIME, ASM, ASTM and Institute of British Foundrymen.

J. G. Mezoff

John G. Mezoff, co-author with H. E. Elliott of *Gating Magnesium Alloy Castings, A New Technique,* was born in Chester, Pa. . . . Matriculated at Purdue University, West LaFayette, Ind., and graduated in 1942 with a Bachelor of Science degree in metallurgical engineering . . . In May, 1942, became associated with Dow Chemical Co., Midland, Mich., as research metallurgist . . . Assumed his present position as production manager, Saginaw Bay Industries, Inc., Bay City, Mich., early in 1946 . . . Wrote for American Foundryman last year on how mold materials affect magnesium casting quality . . . A.F.A. and ASM member.



G. R. Targett

Treasurer, Sibley Machine & Foundry Corp., South Bend, Ind., G. R. Targett, covers the subject *Costs and Pricing Key Foundry Operating Factors* in this issue . . . Brazil, Ind., his hometown . . . Bowling Green Business University, Bowling Green, Ky., is his alma mater, graduating in 1923 . . . Following graduation joined Studebaker Corp., South Bend, accounting depart-

ment . . . Five years later (1928) was appointed manager, export accounting . . . In 1931 was made treasurer, Chicago branch, Pierce-Arrow Motor Car Co. . . . Returned to Studebaker in 1934 as tax accountant . . . Joined Sibley Machine & Foundry Corp. as office manager and assistant treasurer (1938) . . . Was given his present position in 1945 . . . Holds A.F.A., National Founders Association and Gray Iron Founders Society memberships.

N. J. Henke

Like many other General Motors Corporation employes the author of *Material Handling in Malleable Processing,* N. J. Henke, is a product of the General Motors Corporation's training program . . . He claims Flint, Mich., as his hometown . . . Attended and was graduated from General Motors Institute of Technology, Flint (1940) . . . Upon graduating was made foreman, Saginaw Malleable Iron Div., General Motors Corp., Saginaw, Mich. . . . The following year was appointed supervisor of standards and in 1943, general manager . . . Transferred to the Danville, Ill., plant, Saginaw Malleable Iron Div., he assumed the position of production manager . . . At present is superintendent of the Saginaw, Mich., plant having returned there last year . . . Member of A.F.A.

G. Vennerholm

G. Vennerholm is a native of Sweden, born in Stockholm . . . Part author, with L. C. Tate, of *Determination of Molten Metal Temperatures* . . . Mr. Vennerholm graduated in 1920 from Stockholm's College of Technology and continued his studies at Dresden, Germany . . . In 1924 he came to the United States and joined the laboratory staff, Ford Motor Co., Highland Park, Mich. . . . From 1933-38 Mr. Vennerholm was located at Daginham, England, as supervisor of the reorganizing of the foundries of the Ford Motor Company in England and Europe . . . He made monthly supervising trips to France and Germany . . . After returning from abroad he joined the chemical and metallurgical department at the Rouge plant . . . He has remained with this department since . . . Is now assistant head of chemical and metallurgical research at the Rouge plant . . . Is a frequent writer for the trade press and has written previously for A.F.A. conventions and other technical societies . . . Is a member of both A.F.A. Malleable and Steel Division's Program and Papers Committee . . . Also a director of the A.F.A. Detroit chapter . . . Member of A.F.A.

K. E. Rose

Co-author, with C. H. Lorig, of the paper *Copper Addition Contaminants Effect on Mechanical Properties of Gray Cast Iron* . . . Mr. Rose was born in Winfield, Kansas . . . Attended Southwestern College, Winfield, Kansas, 1933-35 . . . Obtained his metallurgical engineering degree from Colorado School of Mines, Golden in 1939 . . . His master of science degree in engineering was received from Cornell University, Ithaca, N. Y. . . . Mr. Rose began his industrial career in 1936 as junior engineer in government service assigned to southwestern Colorado . . . During the period 1939-41 was an engineering trainee, Caterpillar Tractor Co., Peoria, Ill. . . . Served as instructor and administrative assistant, Cornell University, for the two years 1941-43 . . . Appointed research engineer Battelle Memorial Institute, Columbus, Ohio, in September, 1943 . . . Last year Mr. Rose was named associate professor of materials, University of Oklahoma, Norman . . . An A.F.A. and AIME member.

F. P. Goettman

Author of *Foundry Sands, Marketing Preparation,* Franklin P. Goettman, hails from the Quaker state . . . Born in Pottstown . . . Graduated from Pennsylvania State College, State College, Pa., with a Bachelor of Science degree in geology . . . For 10 months, 1941-42, was associated with United Clay Mining Corp., Trenton, N. J., as production control engineer . . . Was appointed junior engineer, Panama Canal, Cocoli, Canal Zone until 1943 . . . Returned to the states and joined the staff of George F. Pettinos, Inc., Philadelphia, as research manager . . . In 1944 entered naval service and returned to his position with the Pettinos organization, 1946 . . . Holds memberships in AIME and American Mineralogical Society.

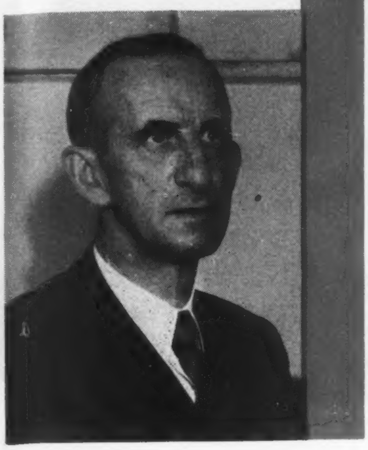
The Foundry Is A Good Place To Work

W. H. Henson

See: *Special Refractories, Metal Melting* . . . Mr. Henson's place of birth was Villa Grove, Ill. . . . In June, 1928, was graduated from University of Illinois, Urbana, with a Bachelor of Science degree in ceramic engineering . . . Has been affiliated with Norton Company, Worcester, Massachusetts, since 1929 when he was appointed refractories engineer . . . Was named chief sales engineer in 1943, the position he maintains at the present time . . . Has written articles for ceramic publications on special refractories . . . Member of American Ceramic Society.

H. H. Fairfield

An enlightening article on *Scientific Research and the Canadian Foundry Industry* has been contributed to this issue by H. H. Fairfield . . . Mr. Fairfield was born in St. Catharines, Ont., Canada . . . Entering the castings industry in 1933, the author was foundry apprentice, McKinnon Industries, St. Catharines . . . Finishing his apprenticeship in 1937 he attended General Motors Institute, Flint, Mich., obtaining industrial engineering training, specializing in foundry technology . . . Returning to McKinnon later in 1937 as foundry engineer, he aided in establishing a mechanized foundry in that plant . . . From 1940-46 was a staff member, Bureau of Mines, Physical Metallurgy Research Laboratories, Ottawa, Ont. . . . His duties during the war years were many, such as being consultant for a number of Canadian foundries requiring metallurgical assistance, performing research on war production problems and setting up and directing an experimental foundry . . . Recently joined Harry W. Dietert Co., Detroit, as foundry consultant . . . A member of A.F.A. Sand Division's Committee on Physical Properties of Iron Foundry Molding Materials at Elevated Temperatures and Committee on Physical Properties of Non-Ferrous Sands at Elevated Temperatures . . . Has written quite extensively for the trade press concerning quality control in metallurgical processes and general foundry practices . . . Last year, with Henri Louette, published in AMERICAN FOUNDRYMAN a paper on core sands . . . Is a member of ASM, Canadian Institute of Mining and Metallurgy and A.F.A.



DEVELOPMENT OF METHODS & STANDARDS NEEDS COORDINATING

THE SKILLED all-around foundryman has been gradually disappearing since World War I, and during this same period the foundry has been mechanizing, standardizing and increasing the use of scientific controls. This trend was greatly accelerated during World War II because of the necessity for rapidly using large numbers of unskilled help to produce quality castings.

These methods and standards will have to be retained and further improved, since many casting buyers are now quality conscious and competition will gradually become keener.

The interest shown by foundrymen in the exhibits and in the technical meetings of their society indicates that they are more keenly aware of the necessity for applying the scientific advances of recent years.

Most foundrymen are also aware that a selling job must be done to attract the right kind of workers and technicians to the foundry. The impression that the foundry is an undesirable place to work must be corrected. *The Foundry Is a Good Place To Work,* and this fact must be publicized. The foundry offers a greater variety of interesting problems than to most other industries. To the technician it offers many problems in metallurgy, chemistry and physics. The work of the operator is usually far less monotonous than that of operators in most other industries.

The old impression that foundry work is a hit-or-miss proposition, run entirely by rule-of-thumb, still persists in some quarters. This is no longer the fact; the modern foundry is scientifically operated and processes and inspection procedures are carefully controlled to produce uniformly good products.

While we are making greater technical advances every year, we still have plenty of room for improvement. A great deal of experimental work has been performed on gating and risering, but much of this work is still carried on purely on the basis of past practice and experience. Experience may show us how to gate a casting to secure a usable product, but it does not necessarily follow that this is the best way.

We still have a great opportunity to further improve our practice by research to establish principles of gating which can be used (with some modifications) by all foundries. Data can be developed which will enable us to accurately choose the best size and shape of sprue to run a given casting. We can also determine the best ratio of sprue area to runner and gate area.

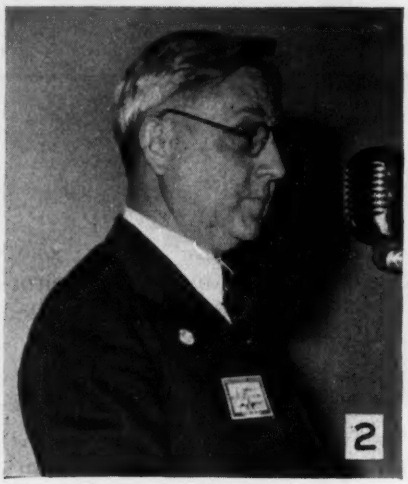
All of these factors can be established, and work along these lines is being carried on by many individual foundries, but a coordination of effort through A.F.A. would develop much greater benefits and would make these benefits available to industry more quickly.

H. G. Lamker

H. G. LAMKER, *National Director*
AMERICAN FOUNDRYMEN'S ASSOCIATION

H. G. LAMKER, A.F.A. National Director, is foundry superintendent, Wright Aeronautical Corp., Paterson, N. J. Born in Pittsburgh, Pa., he received his education from Carnegie Institute of Technology, Pittsburgh. Has been associated with General Electric Co., Johnson Bronze Co., and Aluminum Castings Co., before assuming his present post.

A. F. A.
CONVENTION POINTS THE



1—A.F.A. President-Elect Max Kuniansky, Lynchburg Foundry Co., Lynchburg, Va., (left) and A.F.A. President S. V. Wood, Minneapolis Electric Steel Castings Co., Minneapolis, prior to entering the Grand Ballroom, Book-Cadillac Hotel, for the Annual Banquet. 2—Dr. Jas. T. MacKenzie, American Cast Iron Pipe Co., Birmingham, Ala., presenting the first Charles Edgar Hoyt Lecture. 3—The ladies registered, too. 4—At one of the malleable sessions T. E. Poulson, Belle City Malleable Iron Co., Racine, Wis., (left) shows one of his numerous slides to (left to right) C. F. Joseph, Central Foundry Div., General Motors Corp., Saginaw, Mich.; W. D. McMillan, International Harvester Co., Chicago; and E. M. Strick, Erie Malleable Iron Co., Erie, Pa. 5—A number of A.F.A. committees met during the 51st Annual Convention and seen here is the Deformation Committee, Sand Division. 6—A.F.A. Secretary-Emeritus R. E. Kennedy aids in registering the "Old Timers."

PATH TO FOUNDRY PROGRESS

LIVING UP TO advance notices, the Fifty-first Annual Convention of the American Foundrymen's Association in Detroit set new highs in points of interest and attendance as foundrymen resolved anew to tackle the puzzling problems of production which confront them in today's full-scale operations.

An estimated crowd of 5,000, largest of any non-exhibit year in the history of A.F.A., journeyed to Detroit to participate in the big fact-finding forum. Meeting rooms were filled to overflow proportions for many division sessions, the turnout of A.F.A. members taxing the facilities of Detroit's hotels and the spacious Rackham Educational Memorial. Sessions of the Gray Iron Division attracted throngs of 300 to 400, and attendance at the Annual Business Meeting exceeded 700, an all-time high. Turnout at the opening Gray Iron Shop Course was so large that transfer of the meeting to the main auditorium at Rackham became necessary.

Eager To Learn

It was a serious-minded crowd, bent on acquiring technical data and information that might be pitted against the forces of inertia in stepping up the quantity and quality of castings production. Keynote of the convention was sounded at the opening session by National President S. V. Wood of Minneapolis, and George T. Christopher, president and general manager of the Packard Motor Car Co., Detroit, when they urged that foundrymen take the initiative on an industry-wide scale, modernizing their ideas and methods in preparation for an era of production such as never before known.

Formal opening of the convention took place on schedule, April 28, in Detroit's Rackham Memorial building with A. H. Allen of the Penton Publishing Co. welcoming the visiting foundrymen in behalf of the Detroit chapter of A.F.A. Mayor Edward J. Jeffries, Jr., extended the city's official welcome, assuring the foundrymen they were assembled in an industrial area where a revolution in mechanized operation is in progress and where the problems of the foundry industry are understood.

In greeting the A.F.A. members, President Wood appealed for a strengthening of morale among foundrymen as the industry moves forward. In his travels as National President, Mr. Wood said he found men making their living in foundries who criticize the work in their idle moments. "It's about time we take inventory of our people," he said, "and get back to men who have a high regard for their craft. Our supervision must improve. We are past the time when we can choose as foremen the men with the most sand in their shoes."

Running At Capacity

Warning that the bottle-neck in automobile production may soon shift from steel to castings, Mr. Christopher said the nation's 5,000 foundries can do much better in meeting the demand that confronts them. "Most of the foundries claim they are operating at or near capacity right now," he said. "If this be true, they cannot produce sufficient castings for the automobile industry to meet the demand for five to six million cars a year. The new foundries now being built simply cannot produce enough additional castings to make up the difference."

Pointing to the eleven billion dollar market potential in 1946, Mr. Christopher stated that the foundry industry is a field wide open for ingenuity and enterprise, but that foundrymen need to sell themselves on the bright prospects facing them and to set about building new acceptance for their industry.

Clean Up Foundries

"The prestige of the foundry as a place to work is possibly at an all-time low," he declared. "Foundry workers left in droves during World War II to do clean and less difficult work, and many have not returned. Most of the replacements seem to lack the capabilities of the old timers, and this is one of the principal reasons why we think we are working at or near capacity but really are not.

"Young men of the type we need, filled with misinformation, are turning up their noses at foundry jobs. To attract better replacements, foundrymen must clean up, redesign and mechanize at a much faster rate. The efficiency of our operations will improve in direct proportion to the number of higher-type replacements we attract."

A crowd estimated as in excess of 700 crowded the Book Cadillac banquet hall to participate in the annual business meeting, to hear the

Charles Edgar Hoyt Annual Lecture and to witness the presentation of awards in the Apprentice Contests sponsored by A.F.A.

In giving the president's annual address, President Wood expressed his gratitude to the members, committeemen and representatives of the executive staff for their support of his administration. He also paid tribute to the chapter activities of A.F.A. as the fundamental source of the organization's strength. Growth of membership to the all-time high of more than 9,400 he attributed to the growing interest in the scientific approach to common industry problems and to the pooling of progressive ideas which the Association makes possible. Mr. Wood expressed the hope that some form of overall coordination might eventually and more closely unite the purposes of the various foundry associations.

Winners of the 1947 Apprentice Contests, who were brought to Detroit as a reward for their skills, were introduced at this meeting. (See pp. 108-109 for A.F.A. Apprentice Contest winners.)

Election of Officers

The slate of new Officers and Directors of the Association named by the Nominating Committee was presented by William W. Maloney, Secretary-Treasurer of the Association. President-elect Max Kuniansky of the Lynchburg Foundry Co., Lynchburg, Va. was introduced as were the other newly elected officers present. The complete slate of new executives is presented elsewhere in this issue of AMERICAN FOUNDRYMAN (see pp. 46-47).

B. D. Claffey, General Aluminum & Gray Iron Foundry, Waukesha, Wis. presented an outline of the recently organized Foundry Educational Foundation (AMERICAN FOUNDRYMAN, April, 1947), as one of the Foundation's trustees, and explained the program whereby leading ferrous foundry associations will support foundry educational work in leading technical schools at various points in the United States.

Scholarships Given

Mr. Claffey pointed out that while special foundry courses will not be provided in the program of the Foundation, courses in foundry technique will be organized in the various institutions and facilities for their operation will be provided where required. The granting of scholarships to deserving students enters prominently into the program which will be financed by voluntary contributions from members of the foundry industry. Mr. Claffey was introduced by F. G. Sefing, International Nickel Co., New York, chairman of the A.F.A. Educational Division.

As a concluding feature of the Annual Business Meeting, Dr. J. T. MacKenzie of the American Cast Iron Pipe Co., Birmingham, Ala., delivered the Charles Edgar Hoyt Annual Lecture on the subject "The Cupola Furnace." Virtually all members of the big audience remained throughout the meeting to hear Dr. MacKenzie trace cupola developments historically and practically, describing the trends and "styles" in melting over several centuries. His lecture, a highlight of the convention, will be reproduced in booket form for A.F.A. members.

In recognition of his effort and contribution to the literature, Mr. MacKenzie was presented with a beautiful clock-barometer desk set, the presentation being made by H. M. St. John, Crane Co., Chicago, chairman, lecture committee.

The plant visitation program at Detroit exceeded the fondest expectations of the committee responsible for this annual feature, approximately 1,000 foundrymen visitors accepting the invitation of Michigan foundries to visit plants in the Detroit area. More than 600 visitors

Additional persons and personalities who attended the 51st A.F.A. Annual Convention. 1—G. P. Halliwell, H. Kramer & Co., Chicago. 2—J. B. Caine, Sawbrook Steel Castings Co., Cincinnati. 3—Hon. Edward J. Jeffries, Jr., Mayor of Detroit. 4—W. W. Edens, Ampco Metal, Inc., Milwaukee. 5—Detroit Chapter Chairman A. H. Allen, Penton Publishing Co., Detroit. 6—George Christopher, Packard Motor Car Co., Detroit. 7—J. A. Durr, Albion Malleable Iron Co., Albion, Mich. 8—D. C. Williams, Cornell University, Ithaca, N. Y. 9—(Left to right) C. J. Rittinger, American Car & Foundry Co., Detroit, and D. E. Krause, Battelle Memorial Institute, Columbus, Ohio. 10—A.F.A. President S. V. Wood. 11—A. H. Motley, Parade Publications, Inc., New York.

were accommodated on "Ford Day," alone, May 2, staying over for this special post-convention inspection of the mammoth Ford foundry where millions of cylinder blocks for Ford vehicles are cast annually. The Ford Motor Co. entertained approximately 350 foundry visitors for luncheon at Dearborn Inn, with R. H. McCarroll and other members of the Ford organization acting as hosts. F. J. Walls, International Nickel Co., Detroit, responded for A.F.A. at the luncheon, as a past President of the Association and Honorary Chairman of the Detroit convention committees.

Visitations Popular

The Detroit Committee on Plant Visitations, headed by H. M. Bringhurst of Semet-Solvay Co., was busy throughout the convention arranging inspection parties to the plants of fourteen foundries in the area which held open house.

Two special events during the week were staged as semi-official A.F.A. sessions and both were attended beyond preliminary estimates. On the evening of April 29, nearly one hundred Chapter Officers and Directors attended a special dinner in the interest of better acquaintance and all but five of the current Chapters were represented. National President S. V. Wood presided and President-Elect Max Kuniansky presented the main talk.

In urging the Chapters to play a more prominent part in their community industrial life, Mr. Kuniansky called special attention to the importance of better Chapter programs and urged a greater degree of cooperation between the Chapters and the National organization. He also emphasized the importance of educational activities and particularly of A.F.A. as a training ground for men of the industry. "The importance of A.F.A. Chapters to local foundry management," he said, "cannot be overestimated and oversold."

More than 150 Canadian members and guests attended the special Canadian get-together luncheon on April 30 at which National Director Jos. Sully, Sully Foundry Div., Neptune Meters, Ltd., Toronto, presided. Mr. Sully introduced National President Wood, Director-elect E. N. Delahunt, Warden King, Ltd., Montreal, and the present and incoming Chairmen of both the Canadian chapters.

During the week over 150 Canadian foundrymen registered in the special Canadian "guest book" as evidence of their pride of craft. A total of 200 Canadians registered during the Convention.

Annual Banquet

Climaxing the Convention, some 550 members, guests and their wives attended the Annual A.F.A. Dinner at the Book-Cadillac Hotel, May 1, to honor the new medalists and life members of A.F.A. and to hear the guest speaker, Arthur H. Motley of New York. National President Wood presided and Past-President F. J. Walls, as Chairman of the

A.F.A. Gold Medals and A.F.A. Honorary Life Memberships were awarded at the 51st A.F.A. Annual Convention during the Annual Banquet as follows: Top (Left) H. M. St. John, Crane Co., Chicago (left) receiving the Wm. H. McFadden Gold Medal from Dr. Guilliam Clamer, Ajax Metal Co., Philadelphia; (Center) Chairman, Board of Awards, Fred J. Walls, International Nickel Co., Detroit (left) presents life membership certificate to John Grennan, University of Michigan, Ann Arbor; (Right) R. A. Flinn, Jr., American Brake Shoe Co., Mahwah, N. J. (right) being awarded the Peter L. Simpson Gold Medal by D. J. Reese, International Nickel Co., New York. Bottom (Left) A.F.A. President-Elect Max Kuniansky, Lynchburg Foundry Co., Lynchburg, Va. (left) congratulates R. J. Allen, Worthington Pump & Machinery Corp., Harrison, N. J., for winning the John A. Penton Gold Medal; (Center) H. S. Simpson, National Engineering Co., Chicago (right) gives the Joseph S. Seaman Gold Medal to Rodney Washburn, son of Henry S. Washburn, Plainville Casting Co., Plainville, Conn., as Mr. Henry S. Washburn was ill and unable to attend the convention and (Right) Fred J. Walls hands life certificate to S. V. Wood.

While roving through the Statler and Book-Cadillac Hotels these pictures were taken. 1—(Left to right, standing) H. F. Scobie, A.F.A. Educational Assistant; E. T. Kindt, Kindt-Collins Co., Cleveland; F. C. Cech, Cleveland Trade School; A.F.A. National Director J. E. Kolb, Caterpillar Tractor Co.; and G. J. Gedeon, Aluminum Co. of America; (left to right, sitting) A. F. Pfeiffer, Allis-Chalmers Mfg. Co.; Vaughn Reid, City Pattern Foundry & Machine Co.; H. K. Swanson, Swanson Model & Pattern Works, East Chicago, Ind.; and V. J. Sedlon, Master Pattern Co. 2—Ladies bound for the Ford plant. 3—Mr. & Mrs. Clyde Frear and Mr. & Mrs. C. L. Rason stop and chat. 4—Plant visitation booth at the Statler. 5—(Left to right) D. W. Gunther, Westinghouse Electric Corp.; R. G. McElwee, Vanadium Corp. of America; E. V. Somers, Westinghouse Electric Corp.; and W. W. Levi, Lynchburg Foundry Co. 6—(Left to right) W. H. Baer, Naval Research Laboratory; H. M. St. John, Crane Co.; and A. K. Higgins, Allis-Chalmers Mfg. Co.

Board of Awards, introduced those who made the presentations of A.F.A. honors as follows:

Wm. H. McFadden Gold Medal—presented to H. M. St. John, Crane Co., Chicago, by Dr. G. H. Clamer, Ajax Metal Co., Philadelphia.

John A. Penton Gold Medal—presented to R. J. Allen, Worthington Pump & Machinery Co., Harrison, N. J., by Max Kuniansky, Lynchburg Foundry Co., Lynchburg, Va.

Peter L. Simpson Memorial Medal—presented to R. A. Flinn, American Brake Shoe Co., Mahwah, N. J., by D. J. Reese, International Nickel Co., New York.

Joseph S. Seaman Gold Medal—presented to H. S. Washburn, Plainville Castings Co., Plainville, Conn., by H. S. Simpson, National Engineering Co., Chicago. In the absence of Mr. Washburn, the medal was accepted by his son and, vice-president of the company, R. R. Washburn.

Mr. Walls presented the certificates of Honorary Life Membership to John Grennan, University of Michigan, Ann Arbor, Mich., and to retiring President S. V. Wood.

In his address on *"Tradition—an Asset or a Liability,"* Mr. Motley stressed the importance of constantly seeking new ways to improve services and production, citing instances in which the break away from tradition has brought phenomenal improvements in many fields. He urged the foundry industry to take stock constantly of its own products and operations to the end that the foundry industry may constantly progress and receive its full share of recognition as one of the vital basic occupations.

GRAY IRON

DUE TO THE efforts of R. G. McElwee, Vanadium Corp. of America, Detroit, as Chairman of the Detroit Shop Operation Course Committee, an overflow crowd attended all of the four sessions of the gray iron shop course this year, held each day of the Convention. In fact, the "SRO Sign" was hung out more than once at the 1947 shop course meetings.

The first Gray Iron Shop Course session, the afternoon of April 28, was presided over by E. J. Burke, Hanna Furnace Corp., Buffalo, N. Y., and J. E. Coon, Packard Motor Car Co., Detroit. W. W. Levi, Lynchburg Foundry Co., Radford, Va., led the discussion on *"Variables Affecting Carbon Control in Cupola Operation."*

Good carbon control means good quality control at the cupola, Mr. Levi stated. Pointing out that carbon cannot be added after the iron is melted, Mr. Levi stressed the importance of making accurate determinations of carbon content in base iron and of the scrap acquired from outside sources.

In analyzing the coke factor, Mr. Levi said the pitch type afforded the highest carbon pick-up, with by-product coke second and beehive third. Combinations of coke types afford control of composition to the desired carbon level. Variables in technique between continuous flow and intermittent tapping were analyzed; also the influence of blast temperature, volume of air in cupola, control of moisture and volume of charges. The importance of keeping accurate records at the cupola showing carbon in the ingoing charge and other

Around the luncheon and banquet tables during the Annual Convention. 1—Canadian members enjoying their luncheon. 2—Engineering School graduates luncheon head table. 3—One of the Annual Banquet tables. 4, 5, 6 and 7—Steel Round Table Luncheon.

factors figuring in the formula was emphasized by Mr. Levi in closing.

The Gray Iron Division's important technical sessions opened April 29 with R. G. McElwee of the Vanadium Corp. of America, Detroit, as Chairman and W. W. Levi of the Lynchburg Foundry Co., Radford, Va., as Co-Chairman.

Presentation of *"Cupola Melting Phenomena"* by D. W. Gunther and E. V. Somers of the Westinghouse Electric Corp., Trafford, Pa., was the first feature. The effect of melting temperature has been generally disregarded, it was said, whereas the effect is actually a potent one, influencing the chemical composition of gray iron melted in a cupola.

The melting temperature also affects the tensile strength and the chill depth of gray cast iron, also the slag composition due to the fact that the amount of oxidation of the iron varies during the melting process.

Welding Cast Iron

Another subject of broad general interest came before this meeting when T. E. Kihlgren and L. C. Minard of the International Nickel Co., Bayonne, N. J., discussed *"Arc Welding of Cast Iron with Nickel Electrodes."* Many examples of successful welding were cited.

"A certain percentage of defective castings is inevitable in the production foundry," it was observed. "In many cases, a reasonable proportion can be salvaged by arc welding, thus reducing the percentage of rejects. Such defects as misruns, sand wash, cold shuts, and external shrinks often can be corrected. Such factors as size, shape, initial cost of the castings, the magnitude, nature and location of the defect must be weighed in deciding, first, the feasibility of welding salvalge and, second, whether or not the reclamation is economically justified."

At the Gray Iron Shop Course on April 29, W. W. Levi of the Lynchburg Foundry Co., Radford, Va. was Chairman and C. J. Rittinger, American Car & Foundry Co., Detroit, Co-Chairman. The high rate of interest in melting factors, prominent throughout the convention, was again in evidence as D. E. Krause of Battelle Memorial Institute, Columbus, spoke on the subject, *"Effect of Coke Quality on Cupola Melting."*

"Cupolas having stack heights of less than 12 feet should be rebuilt or altered in order to increase the height to at least 14 feet, and preferably more," he said.

"Improved operation will result if more attention is given to supervision of the charging operation. Undesirable melting conditions in the cupola caused by poor charging will result in cold iron at the spout. However, by the time the cold iron is observed at the spout, it is too late to correct the poor charging responsible for the condition.

"If melting conditions in the cupola are correct as to bed height, air to coke ratio, and coke to iron ratio, it is entirely possible that a good quality of iron can be produced at temperatures below 2750° F. In such an event, it is highly important that the loss in temperature of the iron after it leaves the cupola is kept to a minimum. Although the fluidity of the iron or its ability to fill a mold depends on the composition, superheat is one of the most important factors. Therefore, with lower spout temperatures, it is highly important to decrease the temperature losses during handling so that the iron reaches the mold at a safe temperature. There is hardly any cupola operation that cannot be improved in some respect with reference to obtaining more uniform iron temperature, higher iron temperatures, and the use of less coke."

Coke Survey

At the morning session, April 30, with B. P. Mulcahy of Indianapolis, presiding and H. W. Stuart of the U. S. Pipe & Fdy. Co., Burlington, N. J., functioning as Co-Chairman, D. E. Krause and H. W. Lownie, Jr. of Battelle Memorial Institute, presented the results of a *"Survey of Foundry Coke Characteristics."*

Experimental studies made in this

field over the past decade were reviewed in the report which pointed out that foundrymen still have no laboratory test enabling them to predict reliably the behavior of coke in the cupola. The report shows, however, that a fresh start

Among those present at the 51st A.F.A. Annual Convention were the following men. 1—(Left to right) J. H. Lansing, Malleable Founders Society, Cleveland; A. M. Fulton, Northern Malleable Iron Co., St. Paul; and C. F. Lauenstein, Link Belt Co., Indianapolis. 2—(Left to right) G. R. Gardner, Aluminum Co. of America, Cleveland; R. E. Morey, Naval Research Laboratory, Washington, D. C.; O. J. Myers, Werner G. Smith Co., Minneapolis; and K. J. Jacobson, Griffin Wheel Co., Chicago. 3—(Left to right) Fred J. Walls, International Nickel Co., Detroit; A. T. Waterfall and C. E. Hoyt. 4—(Left to right) M. E. Annich, American Brake Shoe Co., Suffern, N. J.; J. A. Westover Westover Engineers, Milwaukee; H. W. Nickel, American Brake Shoe Co.; and R. J. Fisher, Falk Corp., Milwaukee. 5—(Left to right) R. L. Lee, Grede Foundries Inc., Milwaukee; W. E. George, Booz, Allen & Hamilton, Chicago; C. E. Westover, Westover Engineers; and G. E. Tisdale, Zenith Foundry Co., Milwaukee. 6—(Left to right) E. C. Troy, Dodge Steel Co., Philadelphia; H. A. Schwartz, National Malleable &Steel Castings Co., Cleveland; and Dr. V. Pachkis, Columbia University, New York. 7—(Left to right) E. J. Bush, Navy Yard, Washington, D. C.; W. M. Ball, Jr., National Lead Co., Cincinnati; and E. W. Horlebein, Gibson & Kirk Co., Baltimore, Md. 8—(Left to right) H. C. Stone, Belle City Malleable Iron Co., Racine, Wis.; W. E. Thomas, Magnaflux Corp., Chicago; H. R. Youngkrantz, Apex Smelting Co., Chicago; and (standing) E. L. LaGrelius, American Steel Foundries, East Chicago, Ind. 9—(Left to right, standing) V. J. Sedlon, Master Pattern Co., Cleveland; and A. F. Pfeiffer, Allis-Chalmers Mfg. Co., Milwaukee; (seated, left) W. G. Schuller, Caterpillar Tractor Co., Peoria, Ill.; and C. R. Simmons, Durez Plastics & Chemical Inc., No. Tonawanda, N. Y. 10—(Left to right) K. E. Rose, University of Oklahoma, Norman; J. E. Bowen, Chevrolet Grey Iron Foundry, General Motors Corp., Saginaw, Mich.; H. Bornstein, Deere & Co., Moline, Ill.; C. A. Nagler, Wayne University, Detroit; and E. A. Loria, Mellon Institute, Pittsburgh, Pa. 11—(Left to right, standing) F. W. Von Batchelder and J. H. Schaum, Naval Research Laboratory; R. Schneidewind, University of Michigan, Ann Arbor; and R. W. Lindsay, Pennsylvania State College, State College, Pa. (Left, sitting) H. N. Myers, Perfect Circle Co., Hagerstown, Ind.; and V. A. Crosby, Climax Molybdenum Co., Detroit. 12—(Left to right) G. R. Gardner, Aluminum Co. of America; B. H. Booth, Carpenter Bros., Inc., Milwaukee; H. F. Taylor, Massachusetts Institute of Technology, Cambridge; and H. W. Dietert, Harry W. Dietert Co., Detroit.

has been made in the quest. Difficulty in developing test results from the lack of a specific definition of the factors which constitute coke quality is being experienced.

In a talk on the *"Thermochemical Analysis of Combustion in a Cupola,"* given at the same session M. Edward Flanders of the University of Utah, Salt Lake City presented two equations the use of which makes possible an immediate estimate of the relative effect of preheating blast air, or removal of moisture from the blast, on the heat of reaction or the maximum temperature attainable.

Gas Reduction

"On the assumption that the gas analysis in the cupola is quickly reduced to near 6 per cent CO_2, the effectiveness of these conditioning treatments can be appreciated," Mr. Flanders said.

The third Shop Course session covered *"Factors Affecting Cost of Cupola Operation"* and was presented the evening of April 30 with J. H. Bernard, Eaton Mfg. Co., Vassar, Mich., and K. E. Davis, Cadillac Motor Car Div., G.M.C., Detroit acting as Co-chairmen. Wednesday's discussion leader was L. L. Clark, Buick Motor Div., G.M.C., Flint, Mich.

L. L. Clark of the Buick Motor Div., G.M.C., Flint, Mich., the discussion leader, reminded the gray iron group there is little that can be done about present high cost of coke, but efficient use is important.

Based on a recent investigation, Mr. Clark said coke costs fall within the range of 6 to 11 per cent of total production cost. Foundrymen who can hold the cost at 8½ per cent or less are in position to compete, he continued. Costs, including metal, coke and flux, should fall within the range 25 to 30 per cent of total operating expense in the efficient foundry, he declared.

The Gray Iron division's biggest day was May 1, with six major subjects presented in two sessions. For the morning meeting V. A. Crosby, Climax Molybdenum Co., Detroit, served as Chairman, and H. N. Myers, Perfect Circle Co., Hagerstown, Ind. as Co-Chairman.

In a review, *"Graphite Phase in Gray Cast Iron,"* factors influencing the formation of graphite, cooling rate of the casting, and carbon and silicon contents, were discussed at length by Robert W. Lindsay of Pennsylvania State College, State College, Pa.

"Each specific use for cast iron requires a more or less specific total carbon content," he said. "This total carbon content regulates to a large degree the amount of graphite. It is the job of the foundry supervision to see to it that the amount of graphite is maintained in a wholly pearlitic matrix in most cases, or at least a close approach to the same, and to guide the formation of this graphite as much as possible toward Type A distribution.

Comparatively little research has been done on *"Microstructure of Silvery Pig Iron,"* and efforts to study it required the development of new etchants, according to Richard Schneidewind of the University of Michigan, Ann Arbor, Mich., and C. A. Harmon of the Hanna Furnace Corp., Buffalo, whose recent investigations were described.

The studies revealed the structure of this pig iron to be a matrix of alpha silico-ferrite with large hyper-eutectic graphite flakes and small eutectic flakes. The grain shape varies, the crystals being equiaxed or elongated. X-ray diffraction indicates that the silico-ferrite in the silvery irons studied is the same, the speakers said.

"Micro-Radiography of Gray Iron," a description of the technique by which graphite in gray cast iron may be studied with x-ray equipment, was presented by E. T. Salkovitz, J. H. Schaum and F. W. Von Batchelder of the U. S. Naval Research Laboratory, Washington, District of Columbia.

Iron Target Tube

An industrial type tungsten-target x-ray tube is suitable for the study of graphite in gray iron, they reported, but better results may be obtained with an iron target tube.

With plate Type V, graphitic and dendritic structure may be detected and magnified at least 30 diameters in cast iron specimens measuring 0.005 in. thick by using tungsten radiation for 30 seconds at 60 kilovolts and 10 milliamperes at a distance of eight inches.

By means of micro-radiographic techniques, graphite in gray iron is found to be wider, longer, and more uniform in shape than by metallographic examination.

At the closing Gray Iron Session, H. Bornstein of Deere & Co., Moline, was the Chairman and J. E. Bowen of the Chevrolet Grey Iron Foundry, General Motors Corp., Saginaw, Co-Chairman.

The use of copper-alloy scrap as a source of copper for cast iron may offer some economic advantages if the accompanying elements are not harmful to the iron, declared K. E. Rose (now at University of Oklahoma, Norman, Okla.) and C. H. Lorig of Battelle Memorial Institute, Columbus, Ohio, in a report on *"Effect of Copper Addition Contaminants on Mechanical Properties of Gray Cast Iron."*

Chill Producers

When aluminum, antimony, arsenic, beryllium, bismuth, cadmium, lead, tellurium, tin, and zinc were added with one per cent copper to molten gray iron, statistical analysis of the results showed that only lead and bismuth were consistently harmful, they reported. None of the other elements is likely to cause trouble, except for the chill-producing tendency of tellurium.

Chas. A. Nagler of Wayne University, Detroit, and Ralph L. Dowdell of the University of Minnesota presented a paper titled *"Isothermal Transformation of Molybdenum Cast Iron"* which concluded that isothermal heat treatment of gray and alloyed cast irons should result in improved mechanical properties of the metal being treated.

This treatment should also make practical the heat-treating of more complicated castings because salt bath quenching is less drastic than oil or water quenching, they said.

Reporting on a study of *"Silicon Carbide Inoculation of Gray Cast Iron,"* E. A. Loria and A. P. Thompson of Mellon Institute, Pittsburgh, and H. D. Shepard of Kerchner, Marshall & Co., Pittsburgh, said the normal chilling tendencies of unalloyed and alloyed chilled irons can be controlled with the inoculation. In the irons studied, silicon carbide inoculation produced an improved chilled surface structure

in which the primary carbides are much finer and more uniformly dispersed. The chill is devoid of a highly dendritic structure with its attendant planes of weakness along which failure can propagate, it was stated. The refining action provided by silicon carbide inoculation is such as to produce a carbide microstructure which is known to possess improved physical properties. In chilled iron this means maximum toughness, strength and resistance to impact.

The concluding Gray Iron Shop Course session took place Thursday afternoon and H. H. Wilder, Eaton Mfg. Co., Vassar, Mich., presided. G. A. Timmons, Climax Molybdenum Co., Detroit, acted as Co-Chairman. *"Variables Affecting Electric Furnace Gray Iron"* was the interesting subject at this meeting with K. H. Priestley, Vassar Electroloy Products Inc., Vassar, Mich., conducting the informal and practical discussion period.

STEEL DIVISION

SUBJECTS ON THE AGENDA of the Steel Division's technical program related directly to investigations rated outstanding in today's forward-looking metals technology. As the division program got under way, April 29, C. W. Briggs of the Steel Founders' Society of America, Cleveland, was presiding and L. H. Hahn of the Sivyer Steel Castings Co., Chicago, serving as Co-Chairman.

Sulphur Content

Reporting *"Some Effects of Melting Practice on Properties of Medium-Carbon Low-Alloy Cast Steel,"* J. G. Kura and N. H. Keyser of Battelle Memorial Institute, Columbus, Ohio, said the principal influence of melting practice on the notched-bar impact properties of this steel appeared to be exerted through control of the sulphur content and sulphide distribution.

In general, if sulphur content increased or sulphides were found as a network pattern in the grain boundaries, the notched-bar values were low, they said. In the tests described, the acid steels generally were lower in notched-bar impact values than steels produced by the basic practices. This difference, apparently, is related to the higher sulphur content of the acid steels.

Variations in hardenability in some steels could not be accounted for by the chemistry of the steels, Kura and Keyser said. However, there appeared to be no distinct or consistent influence of any one type of melting or deoxidation practice on hardenability.

Albert P. Gagnebin of The International Nickel Co., Bayonne, N. J., presented observations based on a study of the *"Influence of Selenium on Sulphide Inclusions and Ductility of Cast Steel."* In addition to refining the grain, selenium has the specific ability to coalesce the intergranular sulphides in low-oxide, well-killed cast steel, thereby improving its ductility, he said.

A deoxidation practice for cast steel utilizing selenium was proposed by Mr. Gagnebin. It consists of the ladle addition of 0.08 per cent calcium and 0.05 per cent selenium.

Extensive tests in laboratory and commercial heats show that calcium selenium promoted high ductility in steels ranging from 75,000 to 180,000 psi tensile strength and melted in acid electric, basic electric, and basic open-hearth furnaces, Mr. Gagnebin reported.

Low Ductility

Calcium selenium promoted better ductility and was less likely to produce heats of low ductility than other methods of deoxidation. Moreover, it appeared to accommodate a broad latitude in melting conditions and therefore should assist in the consistent production of high quality cast steel, Mr. Gagnebin declared.

At the second technical steel

The Brass and Bronze Round Table Luncheon attracted a large group of men who received the paper of H. Smith, Federated Metals Div., American Smelting & Refining Co., Pittsburgh, Pa., enthusiastically.

meeting, April 30, C. H. Lorig of the Battelle Memorial Institute, Columbus, Ohio, was the presiding officer and E. C. Troy, Dodge Steel Co., Philadelphia, Co-Chairman.

Under the title *"Slag Control in the Acid Electric Furnace,"* H. H. Johnson, M. T. McDonough and D. L. Radford of the National Malleable & Steel Castings Co., Sharon, Pa., announced results of a study of acid electric furnace slags.

Slag Measurements

Attempted application of slag measurements to the control of several steps in the process, which they described, indicate (a) that such measurements may be useful as an indication of the probable manganese recovery; (b) that they provide a measure (which can be incorporated in the form of quality control charts) to assist in directing the technique employed by several melters and to form a basis for comparison of the performance of several melting units; (c) that they afford an excellent indication as to the progress of the heat and serve as a guide on how to proceed with the working of the heat; (d) that there is some correlation between slag characteristics and the physical properties of the metal produced.

In a report titled *"Application of a Single Slag Process to Basic Electric Steel Making for Castings,"* M. V. Healey and R. W. Thomas of the General Electric Co., Schenectady, N. Y., declared the single slag process capable of producing steel approaching the product of the open hearth in grain characteristics.

The single slag process is not a guarantee of freedom from pinholes if mold conditions are to be ignored, they stated. The investigators also observed that the process produces metal of lower gas content than does the double slag process.

The reducing period in the basic electric furnace performs no useful function in steel making, they observed, except possibly that of recovering oxidizable alloys from the slag. Some reduction in the cost of a heat is accomplished by the elimination of the reducing period, it was stated.

At a steel division session the morning of May 1, J. A. Rassenfoss of the American Steel Foundries,

Additional photographs taken during the 51st Annual Meeting in Detroit. 1—(Left to right) Fred J. Walls, International Nickel Co.; A.F.A. President S. V. Wood, Minneapolis Electric Steel Castings Co.; and oldest living A.F.A. Past President A. T. Waterfall. 2—(Left) A.F.A. President S. V. Wood and Dr. Jas. T. MacKenzie, American Cast Iron Pipe Co. 3—(Left to right) L. J. Ebert, Case Institute of Technology; W. E. Sicha, Aluminum Co. of America; H. H. Fairfield, Harry W. Dietert Co.; and J. C. DeHaven, Battelle Memorial Institue. 4—(Left) Dr. Josef Koritta, Metal and Engineering Works, National Corp., Prague, Czechoslovakia and Andreg Starosta, Zbrogorka Brno Gaua Foundry, Prague, Czechoslovakia. 5—(Left, standing) A. W. Gregg, Whiting Corp.; and S. G. Garry, Caterpillar Tractor Co.; (left to right, sitting) F. C. Cech, Cleveland Trade School; R. S. Falk, Falk Corp.; and B. D. Claffey, General Aluminum & Gray Iron Foundry. 6—Dr. MacKenzie accepting gift from Annual Lecture Chairman H. M. St. John, Crane Co.

East Chicago, Ind. was the presiding officer.

Reviewing the *"Occurrence of Intergranular Fracture in Cast Steels,"* C. H. Lorig and A. R. Elsea of Battelle Memorial Institute, Columbus, Ohio, listed the causes of this peculiar fracture as follows:

1. Aluminum nitride precipitation at the primary grain boundaries.

2. Ferrite precipitation as a network at the primary grain boundaries.

3. Massive carbides in the primary grain boundaries.

4. Extreme cases of Type 11 sulphide inclusions.

5. Internal hot tears.

Steels in which a very fine precipitate of aluminum nitride was responsible for intergranular fracture became increasingly susceptible to the injurious effects of the precipitate, Lorig and Elsea found, as (1) the aluminum content was increased, (2) the nitrogen content was increased, and (3) the rate of cooling after casting was decreased. With the cooling rate of roughly 100° F per hr., precipitation was

(Continued on Page 47)

MEMBERS OF NATIONAL OFFICERS

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Max Kuniansky, Vice President and General Manager of Lynchburg Foundry Co., Lynchburg, Va., was declared elected President of American Foundrymen's Association at the 51st Annual Business Meeting held in Detroit the afternoon of April 30, in accordance with the procedure prescribed in the by-laws of the Association. Mr. Kuniansky will take office as President to serve during 1947-48, at the time of the annual meeting of the Board of Directors in July.

At the same time, W. B. Wallis, President, Pittsburgh Lectromelt Furnace Corp., Pittsburgh, Pa., who served as a National Director during 1943-46, was declared the elected Vice-President for the coming year.

Directors who also were declared elected at the Annual Business Meeting to serve terms of three years each, are E. N. Delahunt, W. J. MacNeill, R. H. McCarroll, John M. Robb, Jr., and A. C. Ziebell.

Elected Vice President
W. B. Wallis
Pittsburgh
Lectromelt Furnace Corp.

Elected President
Max Kuniansky
Lynchburg Foundry Co.

Elected Director
E. N. Delahunt
Warden King, Ltd.

Elected Director
W. J. MacNeill
G.H.R. Foundry Div.,
Dayton Malleable Iron Co.

Max Kuniansky

Max Kuniansky, vice-president and general manager, Lynchburg Foundry Co., Lynchburg, Va., and a past director and vice-president of the American Foundrymen's Association, has been elected A.F.A. National President. He has been one of the most active members of A.F.A., serving on a large number of committees, particularly those affiliated with the A.F.A. Gray Iron Division. His activities in this division were somewhat curtailed due to his serving as vice-president during the past year, although he did take active part in the important activities of the Advisory Committee, Gray Iron Division.

Previous affiliations included: gray iron castings, pig iron qualities, recommended practices for cupola mixtures and others; not withstanding his participation in the work of the Cupola Research Committee, where he has served as Chairman of both the Finance Committee and the Sub-Committee on Scrap.

Interested in A.F.A. chapter activities, he is a member of the Chesapeake chapter and has served as a member of that chapter's board of directors. His various contributions to the Association and castings industry were recognized in 1941 when he was awarded the William H. McFadden Gold Medal of the American Foundrymen's Association.

Mr. Kuniansky, born in Russia, came to this country at an early age and in 1919 at the age of 20 was graduated from the Georgia School of Technology, Atlanta, Ga., with a Bachelor of Science degree in engineering chemistry. He then held posts with the Aetna Explosive Co. (now Hercules Powder Co.) at its plants in Birmingham, Ala., and Ishpeming, Mich., with the National Malleable & Steel Castings Co., and with the American Cast Iron Pipe Co., at Birmingham before going to Lynchburg.

Mr. Kuniansky joined Lynchburg Foundry Co. in September, 1923 as chief chemist. By promotions that began soon after, he served as works manager of both the Lynchburg and Radford plants before becoming assistant general manager in charge of operations. In February, 1934 he became general manager from which position he was elevated to his present post.

A. F. A. ELECT NATIONAL DIRECTORS

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Elected Director
A. C. Ziebell
Universal Foundry Co.

Elected Director
R. H. McCarroll
Ford Motor Co.

President S. V. Wood, on completion of his present term of office, will serve as a Director for one year, as called for in the by-laws.

The by-laws of the Association prescribe that the slate of Officers and Directors prepared by the Nominating Committee shall be published to the membership at least 60 days before the Annual Business Meeting, and permit the submission of additional nominations by written petition filed with the Secretary at any time 45 days prior to the Business Meeting.

The above-named Officers and Directors elected comprised the slate of the 1947 Nominating Committee and their names were published to the membership in the February 1947 issue of American Foundryman. No further nominations being submitted, Secretary Wm. W. Maloney cast the unanimous ballot of the membership at the Annual Business Meeting in Detroit for the election of all nominees.

W. B. Wallis

W. B. Wallis, A.F.A. Vice-President elect, president, Pittsburgh Lectromelt Furnace Corp., Pittsburgh, Pa., has been affiliated with the foundry industry for over 35 years. Is well known by the membership and the foundry industry for his long and excellent service in the various activities of the Association. He served on the board of directors for three years, 1943-46, and during this period of time served on a number of committees in which board members participate.

Born in Pittsburgh, Mr. Wallis was educated in the public schools of that city and graduated from Pennsylvania State College, State College, Pa. He was a member of the class of 1911 and received a Bachelor of Science degree in electrical engineering. Following graduation he began his industrial career by becoming connected with the consulting engineer on the Cheat River Hydroelectric Development for the West Penn Power Co., Pittsburgh. From 1912-13 was affiliated with the Great Shoshone & Twin Falls Water Power Co., Twin Falls, Idaho. He served for a short time as assistant to vice president in charge of operations, Great Shoshone & Twin Falls Water Power Co., Pittsburgh and late in 1913 became assistant sales manager of West Penn Power Co., Pittsburgh.

Entered the consulting field in 1915 with W. E. Moore & Co., Pittsburgh, where he remained for nearly four years. Named assistant general manager, Jessop Steel Co., Washington, Pa., in 1919, he resigned from that post to become associated with his present company where he has remained, rising to the position of president.

E. N. Delahunt

E. N. Delahunt, who has been elected for a three-year directorship of A.F.A., is general superintendent, Warden King, Ltd., Montreal, Que., Canada. Mr. Delahunt brings to the Board of Directors a knowledge of many of the activities of the Association. He has served on various chapter committees, including the Organizing Committee, A.F.A. Eastern Canada & Newfoundland chapter, in 1942. Served as Chapter Chairman 1943-44.

Born in Chester, Pa., he attended

Elected Director
John M. Robb, Jr.
Hickman, Williams & Co.

Elected Director
S. V. Wood
Retiring A.F.A. President

Catholic University of America, Washington, D. C. Graduating in 1917 with a Bachelor of Science degree in mechanical engineering, Mr. Delahunt joined the Bureau of Yards & Docks, Navy Department, as junior engineer. He served, from 1917-19, with the Coast Artillery Corps, U. S. Army, and was discharged a first lieutenant. On assuming civilian status he became associated with F. R. Weller, consulting engineer, Washington, D. C., as a field engineer. Early in 1920 he was appointed engineer, Bridgeport, Conn., division, Crane Co. Transferred to the Montreal, Que., plant (1928) he was made factory engineer. Promoted to plant superintendent, 1933, Warden King, Ltd., he has since received his present position.

W. J. MacNeill

W. J. MacNeill, who has been elected to serve a three year directorship of the American Foundrymen's Association, was born in Lake Mills, Wis. Obtained his Bachelor of Arts degree from Indiana University, Bloomington, (1919) and his masters degree from University of Wisconsin, Madison (1926).

Mr. MacNeill began his association with the foundry industry in May, 1919 when he started as student apprentice, Federal Malleable Co., West Allis, Wis. He had come up through the ranks to become president and general manager, before resigning that position in 1945. He is now general manager, G.H.R. Div., Dayton Malleable Iron Co., Dayton, Ohio.

Has prepared writings for technical societies on foundry problems. Is a member of A.F.A. and Gray Iron Founders Society.

John M. Robb, Jr.

John M. Robb, Jr., who has been elected to serve for three years on the Board of Directors of the American Foundrymen's Association, is resident manager, Hickman, Williams & Co., Philadelphia. Mr. Robb has been participating in the work of Association committees and especially in the activities of the Philadelphia chapter, of which he is a past chairman, vice-chairman and director.

Mr. Robb is a native Philadelphian and matriculated at Temple University, Philadelphia. Enlisted in the Army during World War I, upon being discharged joined the sales staff of Park & Williams, Inc., Philadelphia. In 1931 became associated with his present firm as salesman.

A member of the former Philadelphia Foundrymen's Association, he has been affiliated with the Philadelphia chapter since its inception.

A. C. Ziebell

A. C. Ziebell, president and treasurer, Universal Foundry Co., Oshkosh, Wis., has been elected for a three year term as director. Mr. Ziebell has been active in the affairs of the A.F.A. Foreman Training Committee for a number of years. He has been particularly active in the A.F.A. Wisconsin chapter serving as president in 1941-42.

Mr. Ziebell hails from Appleton, Wis. He early completed engineering, foundry practice and business courses from International Correspondence School, McLain's System and Alexander Hamilton Institute.

Held the position, superintendent of machine shop with Termaat-Monahan Co., Oshkosh, in 1914. Joined Universal Motor Co., Oshkosh, the following year and was assigned to the engineering staff. From 1916-38 was connected with Universal Foundry Co. as secretary and manager. In addition, Mr. Ziebell acted as secretary-treasurer and general manager, Universal Motor Co. during 1929-32. Elevated to his present position with Universal Foundry Co. in 1936.

R. H. McCarroll

R. H. McCarroll, director of chemical and metallurgical engineering and research, Ford Motor Co., Dearborn, Mich., has been elected a national director of the American Foundrymen's Association for a three year period. Mr. McCarroll has been interested in the affairs of the Association for a number of years.

A native of Michigan, he claims Detroit as his home town. Higher education was received from University of Michigan, Ann Arbor, where he obtained a Bachelor of Science degree in chemical engineering (1914). He was awarded an honorary master of engineering degree in 1937.

Following graduation, he was associated with Solvay Process Co. and Semet Solvay Co., Detroit. For three years (1915-18) he was chemical engineer, Ford Motor Co., Highland Park, Mich. At the Rouge plant (1918-22) he was placed in charge of chemical engineering. Until 1944, Mr. McCarroll was in charge of chemical engineering at all plants of the Ford Motor Co., before assuming his present position.

A writer for the trade press he has also prepared papers and articles for a number of technical and professional societies.

Besides his A.F.A. affiliation, Mr. McCarroll is a member of ASM, American Chemical Society, American Welding Society and Institute of Metals (British). As a member of SAE, he serves on the Technical Board, and also as a Director-member of the Engineering Society of Detroit.

S. V. Wood

S. V. Wood, president and general manager, Minneapolis Electric Steel Castings Co., Minneapolis, who is now serving as President of A.F.A., has been elected for a one-year period as a director. During President Wood's term of office, the Association has prospered and attained its greatest membership and increased its number of services to the membership and industry. His election as a director assures the Association of his keen interest and wise counsel for another year. Having also been a member of the Board of Directors (1942-45) and vice-president prior to his assuming the presidency, his experience in Association activities will be of great value to his successors.

He has served on the Executive and Finance Committees of the Board for the past two years.

A past Chairman of the Twin City Chapter of A.F.A., Mr. Wood is a member of the Board of Regents of the University of Minnesota, a director in the First National Bank of Minneapolis, and holds memberships in AIME, ASM, and the Steel Founders Society of America.

CONVENTION POINTS FOUNDRY PROGRESS

(*Continued from Page 43*)

found to occur at approximately 1500° F, and solution of the precipitate was effected by reheating to temperature of 2100° F and higher.

An analysis of *"Segregation in Small Steel Castings,"* was presented by H. F. Bishop and K. E. Fritz (now of Bucyrus-Erie Co., So. Milwaukee, Wis.) U. S. Naval Research Laboratory, Washington, D. C.

Carbon Segregation

Pronounced segregation of carbon, and to a minor degree the other alloying elements, found in small steel castings adjacent to the riser contacts is indicative of potential shrinkage and occurs when restricted riser contacts are used, they declared. Segregated zones are noted in which the carbon content is nearly twice as great as the carbon content of the base metal, he said.

As a result of the research it was concluded that in castings where such segregation occurs, the riser contact consists of solid low carbon dendrites surrounded by liquid high carbon metal during the latter stages of solidification. To supply the last feed metal required by the casting, the interdendritic material is drawn into the casting to form the segregated zone.

The Steel Round Table luncheon on May 1 brought forth another capacity crowd and many well known steel foundrymen for an off-the-record discussion that proved to be a feature of the entire steel program. Two of the best known American steel foundrymen presided—F. A. Melmoth, formerly of Detroit Steel Casting Co., and John Howe Hall, for many years associated with Taylor-Wharton Iron & Steel Co. In some respects the luncheon proved to be a reunion of many luminaries.

The closing Steel Division meeting, May 1, had J. B. Caine of the Sawbrook Steel Castings Co., Cincinnati, for Chairman and C. K. Donoho, American Cast Iron Pipe Co., Birmingham, Co-Chairman.

Under the title, *"Determination of Molten Metal Temperature,"* G. Vennerholm and L. C. Tate of the Ford Motor Co., Detroit, presented a report stating that temperature measuring instruments for foundry use must be accurate within approximately plus or minus 10° F at about 2900° F. These instruments must respond quickly to temperature changes, must be rugged, but portable, and should have low initial and low maintenance costs. Operations should be simple and the instruments must be of the recording as well as the direct-reading type, it was stated.

In a paper on *"Temperature Distribution in Metal Molds,"* M. C. Udy and H. O. McIntire of the Battelle Memorial Institute, Columbus, Ohio, said that, for design purposes, in the substitution of thinner walled molds for centrifugal casting and the use of air or water for cooling it is important to know the temperature distribution in molds of various thicknesses under the different possible conditions of cooling.

Thin Molds Used

Based on studies recently made, it was concluded that thinner molds with air or water cooling could be used to advantage and that, to secure maximum advantage from water cooling and higher conductivity mold material, incorporation of an effective thermal barrier on the hot side of the mold would be desirable.

MALLEABLE DIVISION

TECHNICAL SESSIONS of the Malleable Division, holding sway the first two days in Detroit, featured the presentation of six major subjects.

(*Continued on Page 103*)

A well-attended Canadian luncheon was held during the A.F.A. Annual Convention and the speakers table was made up as follows: (left to right) W. W. Maloney, A.F.A. secretary-treasurer, Chicago; J. A. Wotherspoon, Imperial Iron Corp., St. Catharines, Ont.; E. N. Delahunt, Warden King, Ltd., Montreal, Que.; A.F.A. President S. V. Wood, Minneapolis Electric Steel Castings Co., Minneapolis; Joseph Sully, Sully Foundry Div., Neptune Meters Ltd., Toronto, Ont.; A. G. Storie, Fittings Ltd., Oshawa, Ont.; Harold J. Roast; Henri Louette, Warden King Ltd.; and J. Dalby, Wilson Brass & Aluminum Foundries, Toronto.

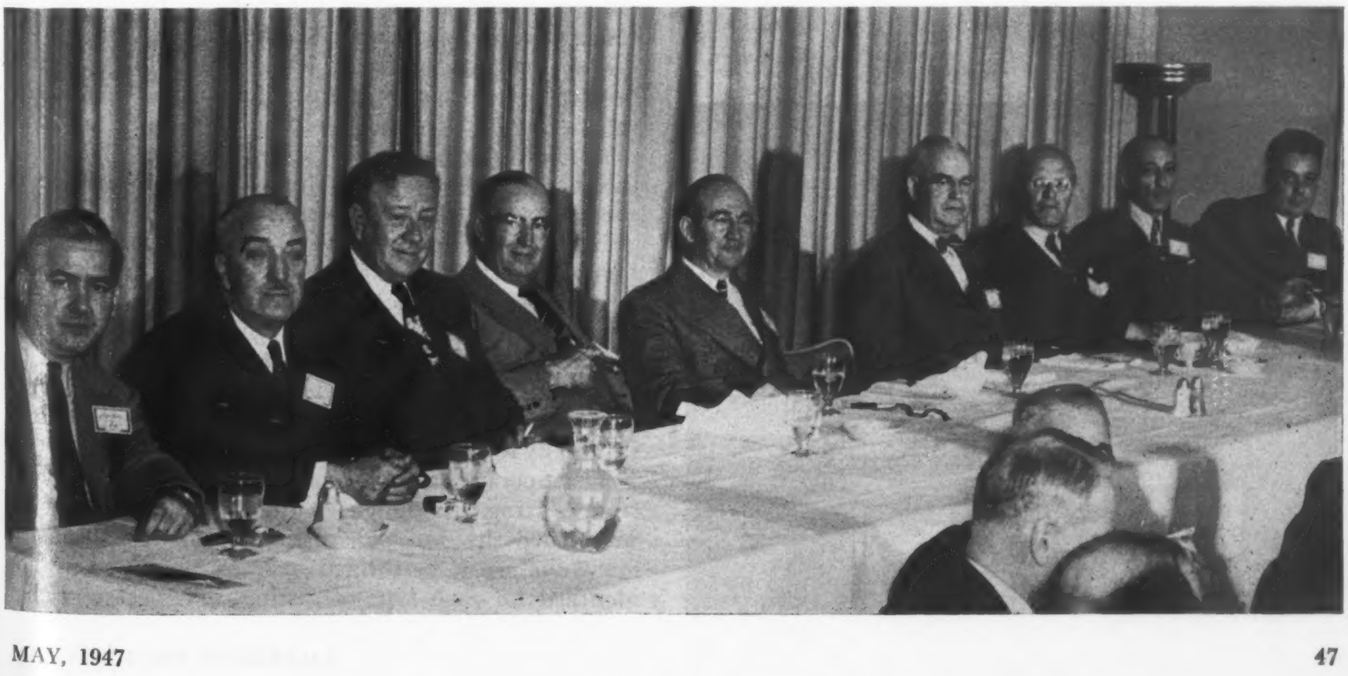


Fig. 1—Sorting castings into storage hoppers and disposal chutes paralleling endless belt conveyor system.

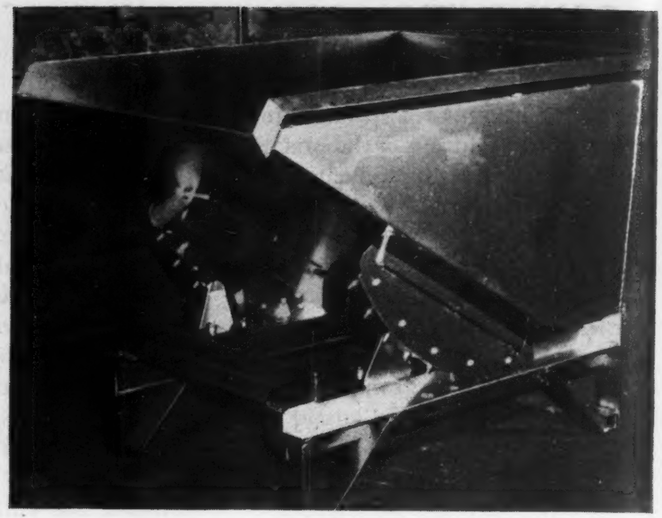


Fig. 4—Dump-type hopper used with high-lift platform truck for moving between and ahead of operations.

Fig. 2—Hoppers receive castings for grinding operation from the paralleling elevated endless belt conveyor.

Fig. 3—High-lift electric platform truck and dump-type hopper form flexible unit for material movement.

MATERIAL HANDLING IN . . .

N. J. Henke
Saginaw Malleable Iron Div.
General Motors Corp.
Saginaw, Mich.

THE PURPOSE OF THIS PAPER is to outline the general principles of good material handling in a processing department as well as to illustrate the economies and improvements that can be realized by the application of these principles.

The material source is a malleable foundry producing approximately 330 production and 150 service castings, varying in weight from 0.3 lb to 86 lb, at an output of approximately 550 tons per day. However, the methods that will be discussed are applicable in small as well as large processing departments.

High production molding practices demand the casting of several pieces simultaneously. Consequently, it is practical and economical to handle the castings by mixed groups in the foundry and through the anneal. However, it is necessary that the castings be sorted in the processing department and that every casting be handled individually several times before it is ready for shipment.

The operations in the processing department vary from sorting the rough castings after annealing to inspecting the finished castings prior to shipping. Since the work performed at each operation is not identical for each type of casting, it is necessary that

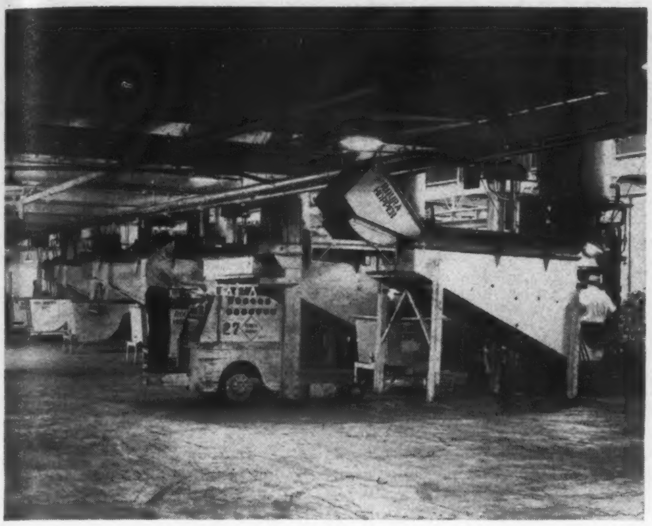


Fig. 5—Transferring a load of castings to large gravity-feed hopper supplying a straightening operation.

Fig. 6—Magnetic crane moves castings from the straightening operation to storage bins and shipping dock.

material handling methods be flexible and diversified.

Belt Conveyor. Powered belt conveyors are effective for operations that involve constant supply of materials in large quantities over a definite line of flow. One such operation is that of sorting the castings after they have been annealed.

Figures 1 and 2 illustrate a sorting system of elevated endless belts arranged in a rectangular manner and paralleled by storage hoppers and disposal chutes. A system of this nature promotes rapid and economical movement of castings from the anneal into the processing department and permits effective sorting directly to the grinding operation without further handling.

Economic material handling is obtained by the use of transporting equipment that is capable of being used for a variety of operations. Such equipment should be designed to permit its effective use under changing conditions and varying rates of production.

The high lifting, electric power, platform truck, Fig. 3, and the dump type hopper, Fig. 4, are the nucleus of efficient and flexible material movement.

Their use enables the rapid movement of large quantities of castings between operations, provides storage ahead of the operations. In addition, there is a rapid turnover of equipment since the hoppers may be dumped into larger capacity stationary bins at each operation. This equipment also makes possible the supplying of materials to the operations by gravity since it is possible to load castings into a container up to nine feet high, as illustrated by Fig. 5.

Magnetic cranes are the best method of moving rough or finished castings to and from storage when inventories are large.

Although magnetic cranes have a high initial cost, this is adequately offset by the fact that they enable piling the castings to great height in bins, thus conserving expensive floor space. They provide flexible and effective movement of castings away from their last operation, thus eliminating the necessity of a great many small capacity disposal containers (tote boxes or dump hoppers). In addition, they are capable of raising large quantities of castings with ease to levels that permit gravity supply for additional handling.

Figure 6 illustrates a 7½-ton bridge-type magnetic crane over a group of finished casting storage bins. This crane is used for moving castings from the straightening presses, Fig. 5, to the storage bins and from the bins to the shipping dock for loading. The loading system will be discussed later in the paper.

Manual Movement by Correlating Operations

The most economical method of moving castings through their processing operations is that of correlating two or more operations in an "in line" manner.

Figure 7 illustrates the correlation operations of an "in line" manner. The processes are Brinell testing and magnetic particle inspection of castings. This system is designed for processing castings varying in nature from valve rocker arms (0.3 lb) to 4¼ in. pistons (10.0 lb) through the following operations:

1. Spot grind Brinell pad.
2. Brinell test (dial indicator type machine).
3. Magnetize each casting.
4. Apply magnetic powder.
5. Visually inspect for cracks and other defects.

Many different types of high production castings

Fig. 7—"In line" movement with double-sided storage hoppers for Brinell and magnetic particle testing.

Fig. 10—This method of counting castings for shipment is slow, inefficient, and fatiguing for the operators.

Fig. 8—"In process" 22-hopper storage system provides flexibility for six-station snag grinding operation.

Fig. 9—Castings of various types are stored in stationary sectioned bins ready for the final visual inspection.

are run through these processes, thus necessitating the efficient flexible performance of each operation. The flexibility is derived by supplying the castings to the operator in double-sided storage hoppers. This enables a different type of casting to be run at each operation without hampering any of the other operations. The efficiency of the operations is derived by good work-place layout.

Processing Operations Vary

It is impossible to recommend definite types of equipment or operations for the application of this method of material movement because processing operations vary greatly in different foundries. However, the following general points provide a guide for the development of an "in line" movement.

1. Select only operations that are, or may be altered to be, of comparable rates of production.
2. Select castings that may be handled efficiently by hand.
3. If several types of castings are to be subjected to the same operation, provide double-sided storage at each operation.
4. Design equipment and arrange machines in a manner that permits the performance of each operation and the transfer of each casting to the next operation while the operator remains in a fixed location.

It would be difficult to devise a production program with which a malleable foundry could produce each day only those castings to be shipped that day. Such a program would require an impractical number of molding stations or an excessive number of pattern changes each day. Consequently, it is imperative that once a pattern has been placed in production, a predetermined quantity of castings be produced to cover known or forecast customer requirements.

However, once the castings have been made, it is a problem of the processing department to store them as finished or to hold them in abeyance of processing.

No hard and fast rule can be applied in determining the size and nature of "in process" inventories. It can be said, however, that these inventories should

Fig. 11—Improved method of counting castings for shipment. Operators may stand erect while handling.

Fig. 12—Snag grinding from tote box to tote box, requiring the operator to move considerable distances.

be controlled sufficiently to prevent their size exceeding the storage and handling capacities of the processing department.

Storing castings on the floor in piles is undesirable since it involves expensive rehandling to pick them up and it contributes to poor housekeeping and bad safety practices. Also, castings which have been sorted may become mixed and require resorting.

Storage Equipment

The ideal theme of "in process" storage is to provide storage equipment for each operation that permits changing the operation from job to job at any time with a minimum of delay, either by moving the desired castings to the operator or by moving the operator to the desired castings.

Moving the castings to the operator is illustrated in Fig. 8 by a snag grinding system of six grinding stations and 22 movable supply hoppers that may be moved as desired by manually pushing from station to station.

Figure 9 illustrates the principle of storing quantities of castings of various types in sectioned hoppers and moving the operators as desired from one bin to another. The operation illustrated is visual final inspection before shipping.

Fatigue. The most elaborate equipment is of little value unless adequate consideration is given to the human element of material handling. As previously stated, each casting in the processing department is handled individually several times before it is finished and shipped. Although the movement from one operation to another may be mechanical, the handling in the performance of the operation is physical. Consequently, there may exist the element of operator fatigue.

The elimination or reduction of fatigue in many cases may require the design of special intricate mechanical equipment. However, most operations may be improved readily by the application of a few motion time analysis principles and the law of gravity.

A comparison of the two methods of counting cast-

Fig. 13—Snag grinding operation improved by raising operators and machines above disposal containers. The castings are supplied from a stationary hopper.

Fig. 14—Straightening operation illustrating crowded working space and haphazard material arrangement.

Fig. 15—Straightening operation improved to give ample unobstructed working space and material supply.

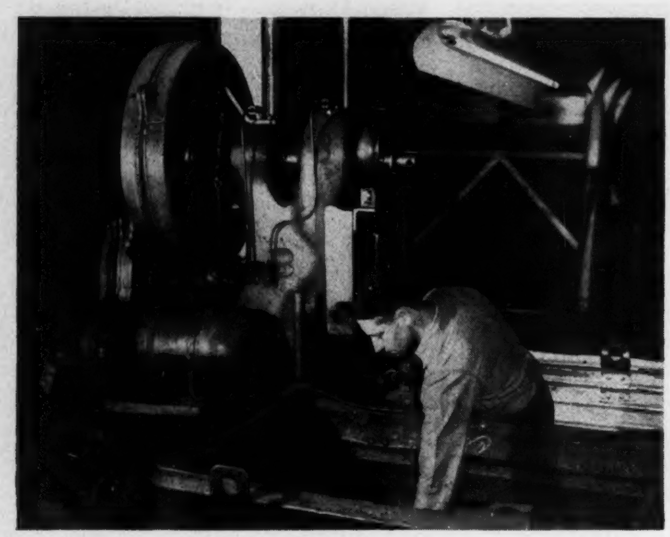
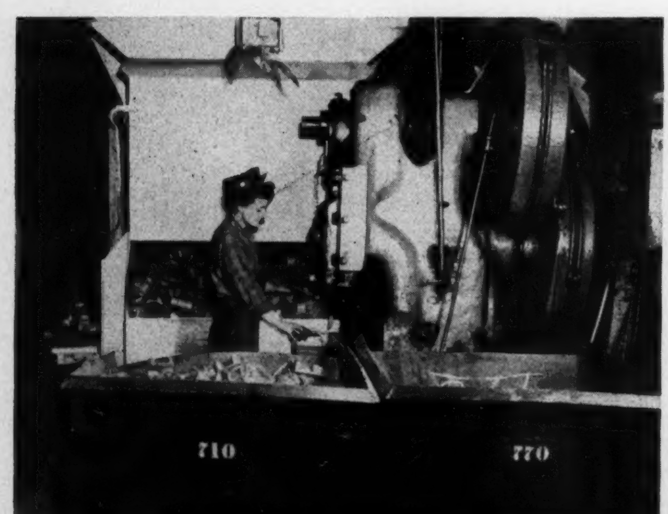


Fig. 16—This shearing operation set-up is undesirable because operator must search in box for castings.

Fig. 17—Improved set-up permits operator to concentrate on casting being sheared while grasping another.



ings for shipment, illustrated in Figs. 10 and 11, demonstrates the improvement possible with the installation of simple equipment.

The method in Fig. 10 required the employees to work in a bent-over position for long periods of time and to handle the full weight of each casting through long distances to transfer it from one box to the other. Having counted the castings, the box would then be weighed and placed in a freight car to be emptied by the same method that it was filled.

Gravity Utilized

The improved method, Fig. 11, permits the employee to stand in a normal, erect position and to count the castings as they slide them from the stationary hopper into the dump type gondola in a downward motion without having to handle the full weight of the casting. The gondola, when filled, need only be weighed and dumped into a freight car.

Figure 12 and Fig. 13 demonstrate the same principles applied to the operation of snag grinding. Here fatigue has been eliminated by raising the operator above point of disposal and by supplying castings to him by gravity at a location about which he need move only short distances in performing his operation.

Working Conditions. Working conditions, although generally associated with lighting, ventilation, etc., are an important phase of the human element in material handling. Good housekeeping is one element of working conditions that may be derived from effective material handling. It will be noted in Fig. 14 that the press operator is confined to a very small area by the two tote boxes, the location of which may vary as the boxes are changed. The hoisting eyes on the tops of the boxes are obstacles that he must avoid every cycle of his operation. Also, if the operator should leave the machine it would be necessary for him to squirm through a narrow opening or climb over one of the boxes.

These undesirable conditions are eliminated by supplying the castings to the operator in a stationary hopper, Fig. 15, and by providing a pit at the right of the press into which the castings may be disposed.

Safety is another element to be considered in developing material handling methods for an operation. A good general rule is to supply the material to the operator in such a manner that he may grasp and transport the casting to the operation without eye-directed movements. This permits the operator to concentrate his attention on the area of the operation where a hazard may exist. Figure 16 and Fig. 17 illustrate shearing operations, and a comparison of the two systems demonstrates principles mentioned.

Conclusion

Many more types and examples of material handling could be discussed. Since each operation requires individual treatment, only an outline of the fundamental principles of good material handling has been presented. However, foundrymen should realize that without adequate and efficient handling methods in the processing department, the most effective practices of economy in the foundry are useless.

Experimental magnesium castings being poured in the foundry research laboratory of the Bureau of Mines.

SCIENTIFIC RESEARCH and THE CANADIAN FOUNDRY INDUSTRY

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Bureau of Mines
Ottawa, Canada

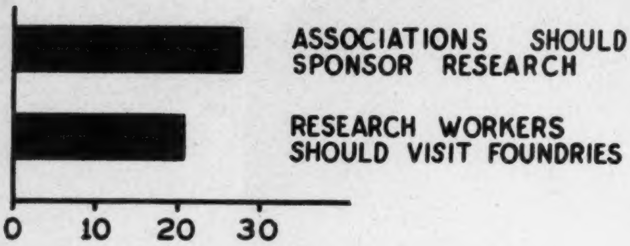
IN ORDER TO COMPLY with the many requests for metallurgical research and development work received by the Bureau of Mines, Ottawa, Canada, it was found necessary to establish a foundry research laboratory. Before setting up a research program the bureau decided to investigate, by means of a survey, the requirements of the Canadian foundry industry.

A letter was sent to each foundry asking for information about the common, everyday problems being encountered in the manufacture of castings, and requesting suggestions for research projects. The opinions of purchasers of castings should also be investigated.

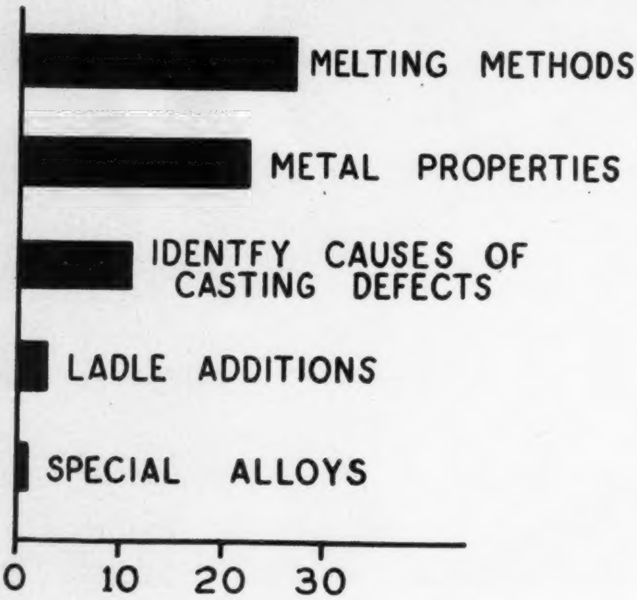
The chart shows the types of foundries and the number of suggestions from each group. Almost half of the inquiries received dealt with the problems of gray iron foundries; while most of the remaining comments were concerned with non-ferrous and steel foundry problems. If research were to be apportioned according to the number of inquiries, the amount of work done would be to the approximate proportions shown in the chart. However, new industries such as precision casting and magnesium foundry work require more basic research before they can be fully utilized.

Sand research problems were mentioned more often than any other type of foundry problem. All foundries are interested in developing a molding sand that will give a smooth casting finish with no surface defects, thereby reducing cleaning costs. This problem is especially serious in the steel foundries, where some operators have reported that it often costs twice as much

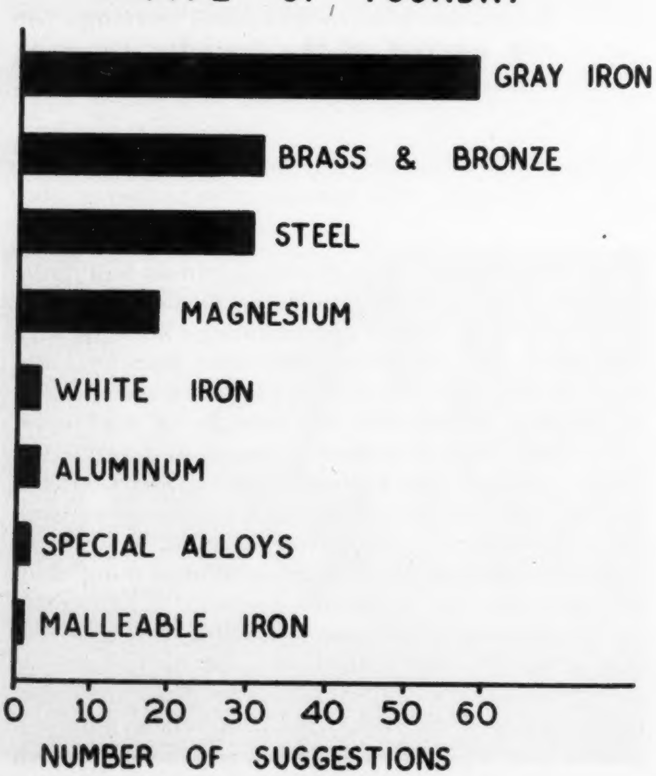
RESEARCH & INDUSTRY CO-OPERATION



METALLURGICAL PROBLEMS



TYPE OF FOUNDRY



to clean a casting as does production to that point.

Canadian foundries in isolated districts must pay as much as 12 dollars per ton freight on sand. British Columbia foundries, for example, are importing sand from Ohio and Tennessee, and they are interested in finding local Canadian sand sources. They are also anxious to develop an inexpensive method of reclaiming used sand. Foundries in every province are interested in finding closer sources of sand.

Sand cores appeared to be a source of considerable dissatisfaction, and some foundrymen reported that core removal is one of the largest items in the cost of production. Interest has also been shown in the relative merits of the large number of commercial sand binders that are available.

The greatest number of inquiries on metallurgical topics had to do with the operation of the gray iron cupola; brass and bronze melting problems were next in frequency. In general, it seems that information leading to better control of melting operations is one of the basic needs of the industry.

Manufacturers who were changing to peace-time production sent in a number of inquiries dealing with the development of special properties of metals. Wear-resistant alloys, corrosion-resistant metals, and heat-resistant iron were some of the subjects mentioned.

Interest in Defect Types

There are certain types of casting defects on which foundrymen would like more information. One of these is the pin-hole blow, which was reported by gray iron, alloy steel, carbon steel, manganese steel, brass and bronze, aluminum and magnesium foundries.

The effect of additions to the ladle before pouring proved of sufficient interest to be made a project for investigation.

Many operators are of the opinion that a large percentage of scrap castings is due to improper gating and risering, and requests have come in suggesting that an investigation be made in this field. Foundrymen look forward to the day when a set of rules will have been worked out to aid in the control of this important foundry technique.

Recent developments in the field of centrifugal casting have aroused considerable interest and more information will be welcomed, especially as it applies to light metals.

The reaction of coke to air and to metal is of interest to a number of cupola operators who have encountered difficulties in melting, and it has been suggested that an investigation on coke reactivity be carried out. Furnace refractories have also been proposed as a project for investigation.

While a number of plant managers are interested in precision casting, they hesitate to undertake this new technique because they believe that a long period of costly trial and error might be necessary before they could get into production. Research laboratories could work out many details of production methods for the foundry industry.

Designers are interested in the amount of strain locked into the casting. The domestic boiler manufacturers and others face the problem of cracking in cer-

tain intricate castings. Most foundrymen are not aware that instruments for measuring strain are available and can be used to work out casting designs.

Many letters received in the survey expressed the opinion that technical and trade organizations should endorse research work for the industry and should aid in determining the investigations most urgently needed. The organizations specifically mentioned were the American Foundrymen's Association, the Gray Iron Casting Institute, the Malleable Iron Institute, the Stove & Furnace Manufacturers Association, the Canadian Metal Trades Association and the Steel Castings Institute of Canada.

These organizations have set up advisory committees which will guide the research activities of the bureau into the most practical fields of investigation. It was also suggested that engineers engaged in research work should visit commercial foundries in order to obtain first-hand knowledge of their problems.

Research laboratories may use several methods of collecting and presenting information to the foundry industry. These methods may be designated as pure research, applied research, production development and education. A brief summary indicating the manner in which research techniques can be applied to help the foundryman follows.

"Pure Research"—More information is needed on the basic laws of the behavior of materials. Examples of this type of investigations are:

a. Studies of the reaction of liquid metal to gases, fluxes, slags, and metallic additions.

b. The reaction of metal to heat, corrosion, cold, and other external influences.

c. The structure of metal and the effect of alloying additions.

"Applied Research"—In this branch the findings of pure research are put to some practical application. Pure research produces individual pieces of a jigsaw puzzle; in applied research the puzzle is assembled to give a new picture of the laws of nature. Examples of applied research are:

a. Properties of new alloys; effects of small amounts of addition agents to metals.

b. Effect of different melting techniques.

c. Effects of experimental sand mixtures upon casting properties.

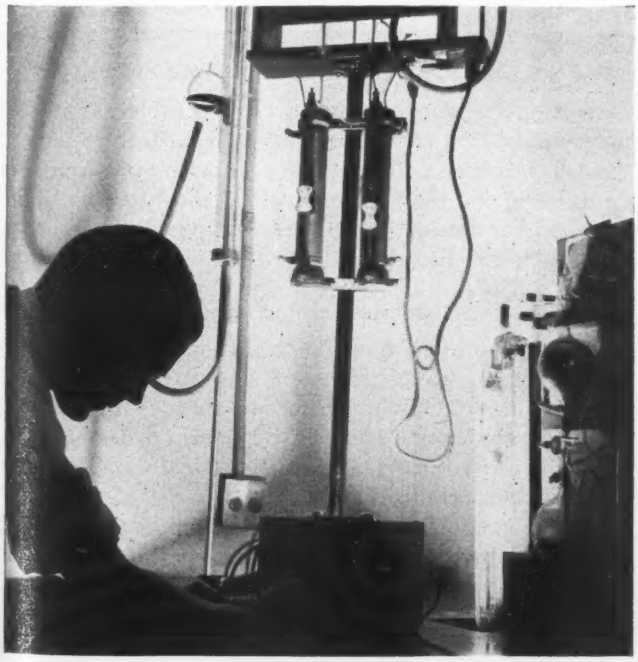
d. Experimental development work on foundry techniques such as centrifugal casting, precision casting and permanent molds.

"Production Development"—A great amount of development and research is being done in the foundry itself. The foundryman must try out new ideas, and fit them into his production operations. Research data frequently only provide information, leaving it to the foundryman to determine the meaning of the information and its proper application in the foundry.

A great deal can be learned by scientific analysis of operating data. This phase of production research and control is sometimes called quality control.

"Education"—Many of the problems mentioned in this survey are of long standing, and a considerable amount of information has already been published on them. However, this information is scattered widely throughout the technical literature, and is not available to most of the foundry operators. There is a definite need for papers and articles summarizing the highly technical information and presenting it in less technical language.

Physics Section—Research on pinholes in castings is aided by determination of the gas content of the metal.



Sand for the experimental foundry is carefully prepared in the sand muller and put through an aerator.

Acknowledgment

Permission of the Director, Mines and Geology Branch, Dept. of Mines and Resources, made possible the publication of this paper. The project was undertaken under the direction of Mr. C. S. Parsons, Chief, Metallic Minerals Division. The writer is indebted to the office staff of the Physical Metallurgy Research Laboratories for handling the correspondence involved, and to Dr. G. S. Farnham, Chief Metallurgist, Bureau of Mines, and Miss K. Bowlby for revision of text.

Temperature DETERMINATION OF MOLTEN METAL

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and
L. C. Tate
Ford Motor Company
Dearborn, Mich.

THE ABILITY TO MEASURE accurately the temperature of the liquid metal in the furnace has for many years been the goal of metallurgists in both the steel mill and the foundry.

When we consider that the whole refining process in steel making is based on a series of chemical reactions which are largely a function of the temperature, and that the degree of solubility of the various gases present such as oxygen, nitrogen, hydrogen, etc., is also governed thereby, the vital importance of this subject is evident.

Many of us who have, furthermore, labored in the foundry with the problems arising from lack of proper temperature control such as dripping roofs, short lining life, not to mention runouts, burn-ins, misruns and ladle skulls will readily appreciate that accurate knowledge of the temperature at all stages of the manufacturing process will make the task of uniformly reproducing quality castings from heat to heat somewhat easier.

It is the intention of this paper to review some of the various methods tried and also to discuss the results of an investigation carried out at the Ford Motor Co.

It may be well before we proceed with our discussion to consider the requirements which must be met by instruments for this type of work in order that the greatest benefit may be secured and the expenditure justified.

Accuracy of Instrument

The instrument must be of such accuracy that the temperature readings obtained do not vary more than ±10° at about 2900° F. Otherwise there is little reason for adopting instruments, in particular when we consider the quite remarkable ability of trained melters in judging temperature by the eye.

With the conditions usually existing on the melting floor, it is, furthermore, necessary that the instrument be sufficiently rugged in its construction to withstand the rather rough treatment to which it will be exposed. It is also of importance that it be readily portable so

that it can be rapidly transported from one furnace to another or moved out of the way when charging.

The operation must also be simple enough so that specially trained personnel will not be required as this would be objectionable, particularly in smaller foundries. In order to secure maximum benefit as well as greatest ease in evaluating the temperature readings, the instrument must be self-recording so that the melter can use the curve produced as an indication of the physical conditions in his furnace at any given time.

Temperature Determination Methods

It is also well to remember that the steel melter, whether in the foundry or in the mill, will never accept an instrument of any type unless its operation and the information obtained convince him that it is to his benefit to use it. It must help to reduce the mysteries of steel making to a science.

Spoon Test Method. The spoon test, where a sample of the metal is removed from the furnace in a spoon previously coated with slag, and the temperature judged either by the eye or read with an optical pyrometer, is probably most common today. The accuracy, however, of this method even when the optical pyrometer is used leaves much to be desired because of the rapid loss of temperature in the spoon, difference in vision, changes in the emissivity of the metal, etc. Furthermore, it seems that most melters prefer to use their own judgment, when they do not agree with the pyrometer man.

Rod Cutting Method. Another method commonly used, particularly in the open hearth, is the rod cutting method where a steel bar is inserted through the wicket hole and submerged in the liquid bath for a given length of time. Upon withdrawal, the temperature of the bath is indicated by the shape of the hot end, high temperatures resulting in a clean straight cut while low temperatures are revealed by a cone shape.

Bath Equalization Method. The bath equalization method, developed by Larsen and Shenk, is based on radiative equilibrium between the roof and the slag surface of the metal. It consists of a photoelectric roof pyrometer which is sighted on the inner surface of the roof and another pyrometer which is sighted downward on the slag. In order to take a reading, the power or the fuel is shut off to permit the metal, slag and roof temperatures to equalize. The equalization at these temperatures is accomplished in less than a minute's time. The point at which the roof temperature and the slag temperature coincide is then used to represent the bath temperature.

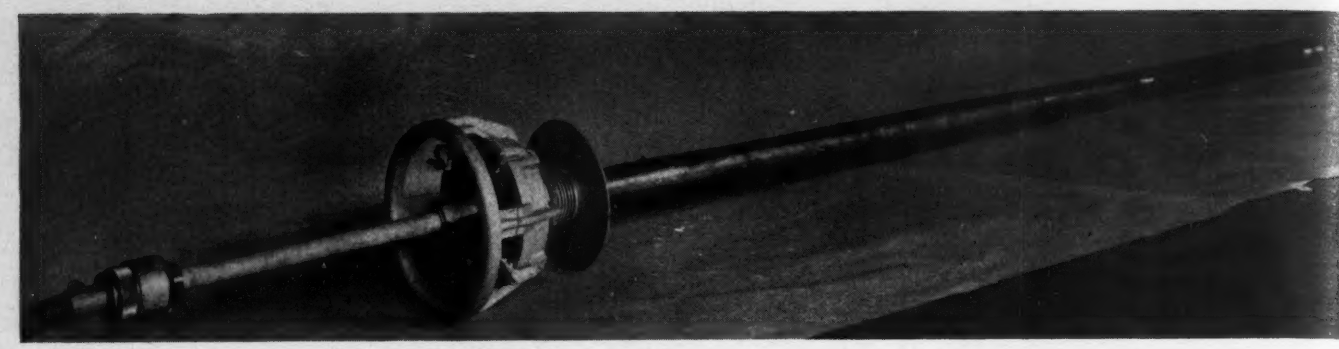
The disadvantage of a method of this type is, however, that the metal itself is not measured and, therefore, considerable errors are apt to result. In addition, the furnace operation must be interrupted at the time of each reading.

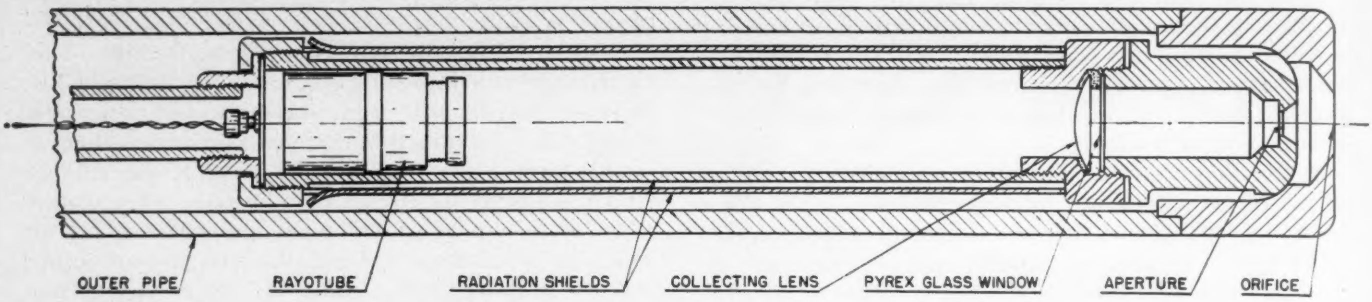
Graphite-Silicon Carbide Method. A graphite-silicon carbide thermocouple first announced in 1933 by G. R. Fitterer, has met with some success according to published data. In principle this instrument is a thermocouple formed by a graphite tube sealed at one end into which is inserted a silicon carbide rod. This is insulated from the graphite through a surrounding air space, except at the sealed end where the two are joined thereby forming the hot junction. To the assembly is attached a graphite extension tube which is mounted in a water-cooled head containing the terminals connected through wires with a potentiometer.

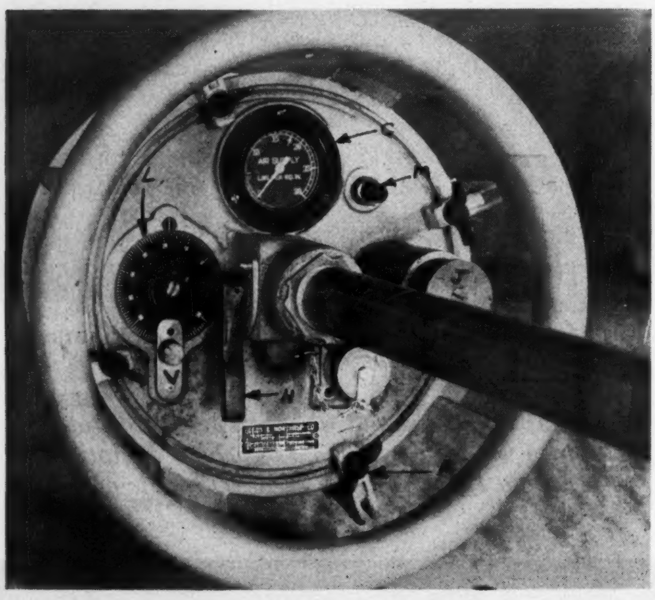
Dissolving Tube Method. The thermocouple principle has formed the basis for several additional methods such as the dissolving tube method which consists of a platinum-platinum-rhodium thermocouple protected by a small porcelain tube which in turn is enclosed in a graphite tube. This graphite tube is set in a water cooled head and the thermocouple leads are led out through a pipe mounted inside one of the two coolant conductors which also act as handling extensions.

The graphite tube is tapered at the end to about one-

Photographs on this and opposite page illustrate operation of immersion unit. The whole operation requires about 12 sec. (see Fig. 9 for schematic diagram).





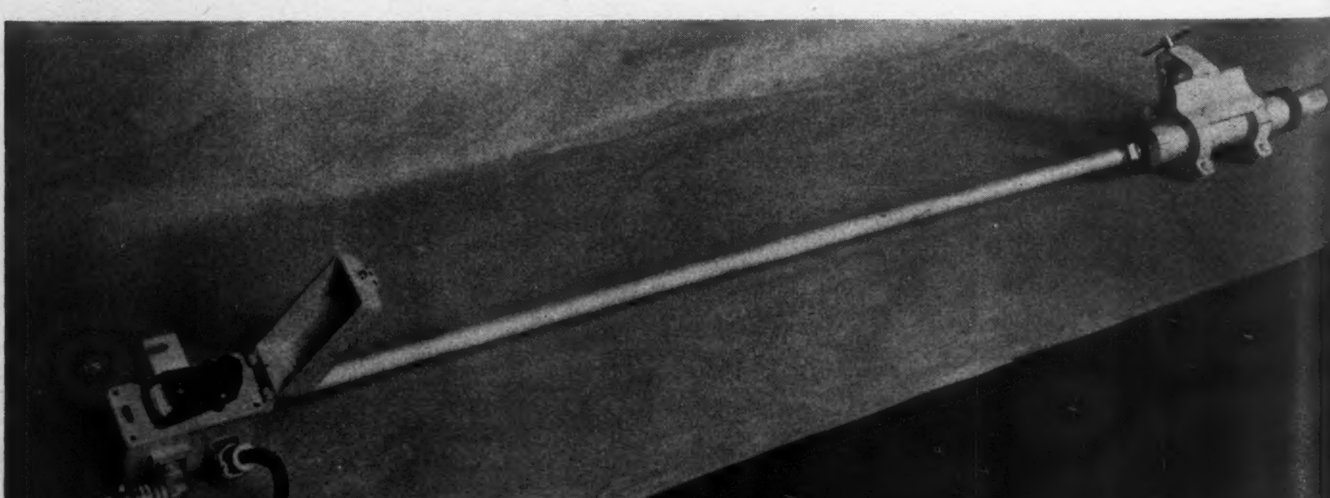


Figs. 1 and 2 (above)—Immersion unit and sectional drawing, radiation tube assembly. Fig. 3 (left)—Control head unit. Fig. 4 (below)—Standardizing unit.

half inch thickness and acts as a protection for the porcelain tube until the same has passed through the slag and into the liquid bath where the graphite burns off exposing the porcelain. The temperature readings are obtained by connecting the leads to a suitable potentiometer. Although in principle the same as a modern version to be described later, this particular method has not proven entirely satisfactory. This is mainly because of the water cooling principle used which frequently does not meet with required safety codes.

Numerous additional instruments have been tried with varying degrees of success but their importance does not warrant discussion.

Instruments Used in the Present Investigation. Realizing the great need for an accurate method for measuring the temperature of the liquid bath, the authors'



company about a year ago made a survey of the various instruments available and selected two, a radiation type pyrometer and an immersion type thermocouple which seemed to offer considerable promise.

Radiation Method. The radiation method was originally developed by F. L. Collins and Carl Oseland in 1936, and later further improved by other investigations. It consists of a 6-ft. length of 2-in. steel pipe provided with a glass window at one end and a steel plug at the other end having an orifice of about one-half inch diameter. The tube itself was connected with a high pressure air line.

By submerging the orifice end of the tube into the metal bath and forcing a stream of air through the opening, a bubble is formed in the metal. Temperature readings are obtained by means of an optical pyrometer sighted through the tube on the inside wall of the air cavity formed at the orifice.

Although this method was found to give consistent readings when operated by an experienced observer, several serious objections were present. The cavity formed in the liquid metal, not being a true black body, i.e., a perfect radiator, necessitated corrections to the pyrometer readings.

The difficulty, furthermore, of having to locate the small orifice and align it with the filament of the pyrometer in the short space of time permissible before the tube softened sufficiently to start bending, was a serious handicap. Also, no automatic record of the temperature could be obtained.

The principle of the Collins-Oseland method, however, forms the basis for a self-recording radiation pyrometer which was selected as one of the instruments to be investigated.

The difficulties encountered by Collins-Oseland have in this instrument been overcome by mounting a thermopile with a suitable optical system, known as a radiation tube, close to the orifice and connecting the same with a self-recording instrument. This instrument eliminates the optical pyrometer and the difficulties connected therewith, and also makes it possible to record automatically all readings.

This instrument in its present form consists of two essential parts: (1) the immersion unit, frequently called the "dunker," containing the photo-electric cell, and (2) the self-recording equipment.

The immersion unit as shown in Fig. 1 is built up of three sections welded together. These consist of a tip which is machined to form a ⅝-in. orifice and also acts as a locator for the aperture, a 2-ft. length of heavy pipe which houses the radiation tube assembly and protects it from the slag and molten metal, and a 6-ft. length of standard pipe to which the control head is attached.

The radiation tube assembly, shown in Fig. 2, con-

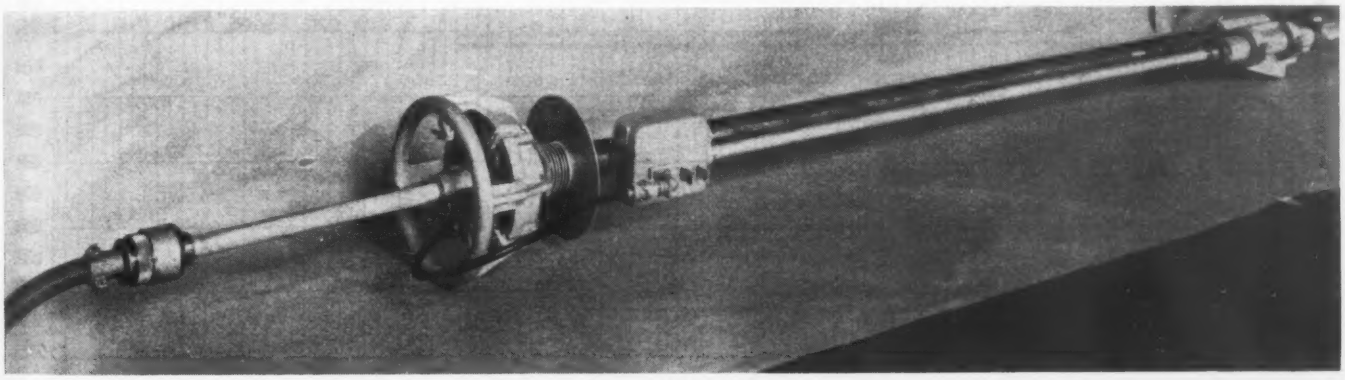


Fig. 5 (above)—Standardizing unit attached to immersion unit. Fig. 6 (below)—The standardizing operation.

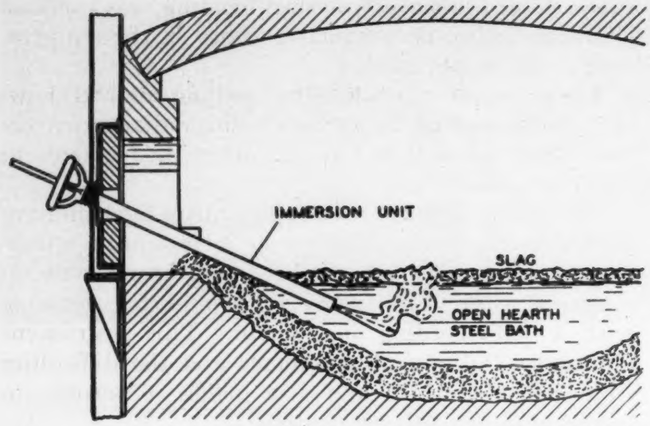


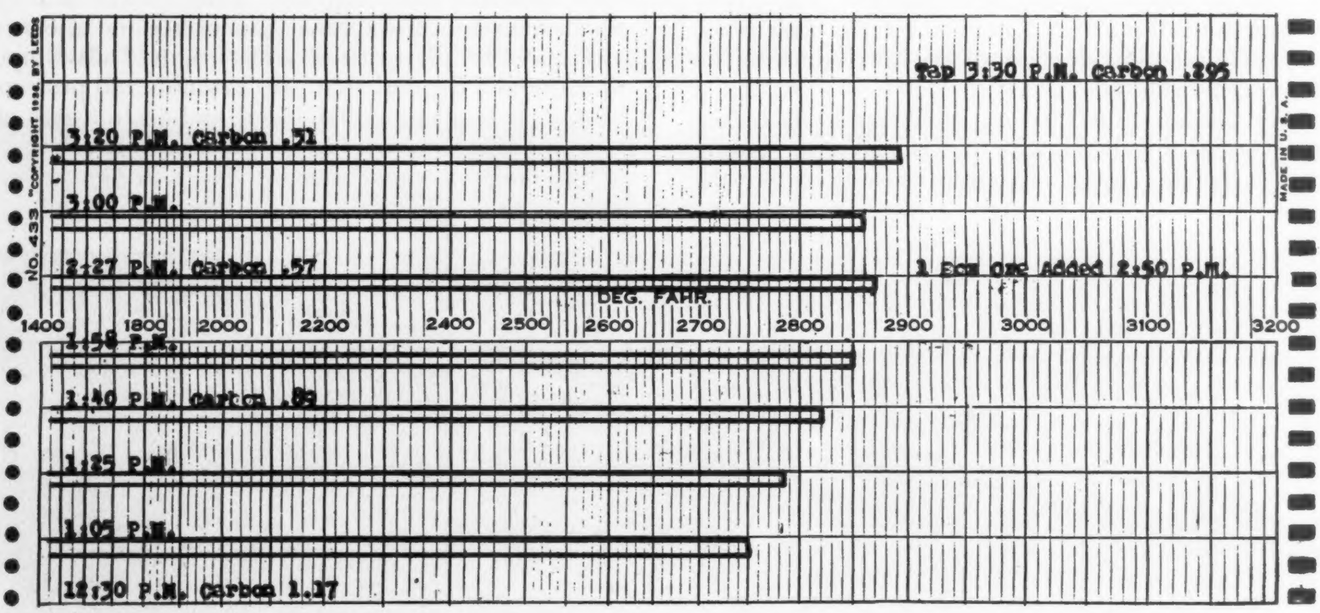
Fig. 7 (above)—Schematic diagram demonstrating operation of the immersion unit in furnace application.

Fig. 8 (below)—A representative temperature chart.

readings are to be obtained, and varies with the depth of immersion. It has been our experience that most satisfactory results are obtained with a pressure of 12 psi. and with the tube immersed approximately 6 in. into the liquid metal.

To assure accuracy, it is advisable to standardize the instrument once a day. A unique method has been developed for this purpose. A standard radiation tube fitted with a galvanometer as shown in Fig. 4 is attached alongside of the immersion unit and plugged into the control head, Fig. 5. The whole assembly is then sighted against the inside wall of the furnace, as indicated in Fig. 6, and the dial on the control head adjusted until a zero reading on the galvanometer is obtained, at which point the dial is locked. In this manner, compensation is made for any dust or foreign matter collected on the instrument.

The operation of the immersion unit in the foundry or the mill is relatively simple and can readily be per-

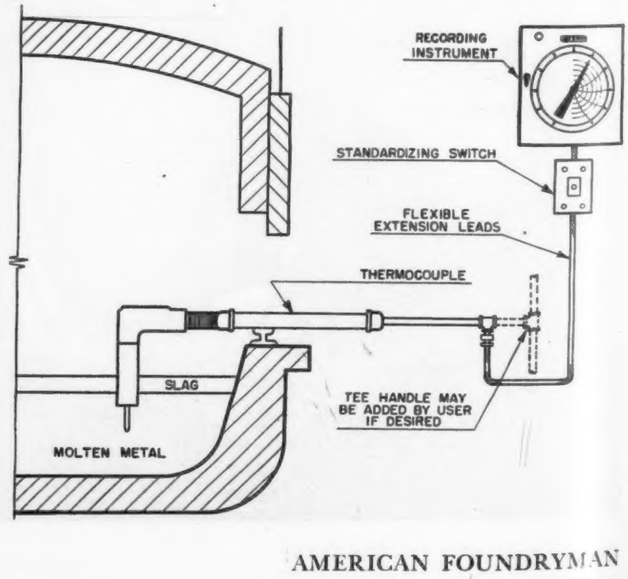


sists of the aperture, slotted at the end for air passage, and attached to it a double walled brass protection pipe. Inside is mounted the collecting lens shielded by a pyrex window and the radiation tube itself. The brass tube is finned to permit some of the air to pass between the inner and the outer wall for increased heat dissipation. Attached to this assembly is a half-inch pipe which connects with the control head and acts an as added protection for the leadwires.

The control head, Fig. 3, is fitted with an air gauge, G, an off and on air valve, H, a switch, J, which permits readings to be taken when the unit is immersed in the molten metal only, a second switch, M, used when standardizing the instrument, and a potentiometer dial, L, for adjusting the tube. Attached to the head is a short length of 1½-in. pipe connecting with an air hose to the reducer station. The leadwires from the head to the recording instrument run inside the air hose for added protection. The recording instrument is a standard recording unit with a range of from 1400°-3200° F and a chart speed of 2 in. per min.

The air pressure used plays a vital part if consistent

Fig. 9 (below)—Schematic diagram showing construction details of thermocouple and application method.



formed by one man. To take a reading, the tube is inserted through the wicket hole and the tip immersed to a depth of approximately 6 in. in the liquid metal. The air valve is held open to allow the air to flow through the orifice and form the cavity, the inner wall of which becomes target for the radiation tube.

As soon as the tube is in place, the pyrometer switch is closed thereby recording the reading after which the tube is withdrawn. The whole operation requires about 12 sec. with an actual contact time between the radiation tube and the recorder of about 2 sec. A schematic diagram, Fig. 7, demonstrates the operation.

The temperatures are recorded on a chart in a manner shown in Fig. 8 which represents an open-hearth heat. Each double line indicates the temperature of a particular reading. As such recordings can be taken at

Fig. 12 (right)—Temperature recorder (circular chart).

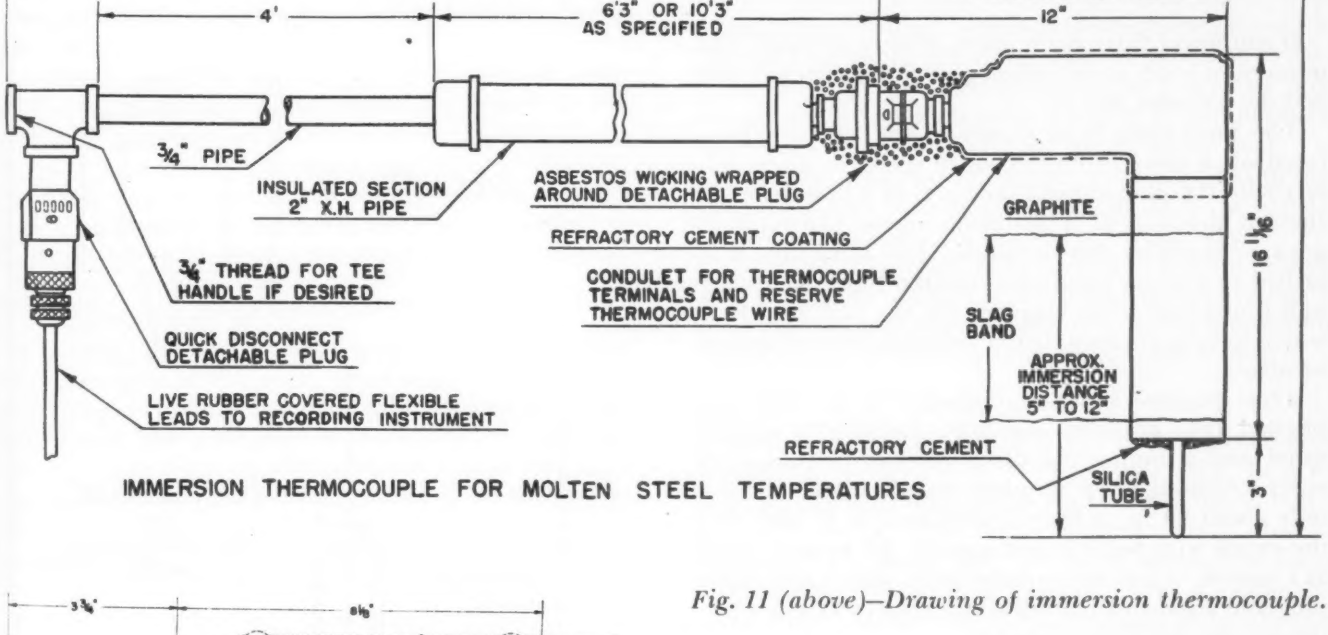


Fig. 11 (above)—Drawing of immersion thermocouple.

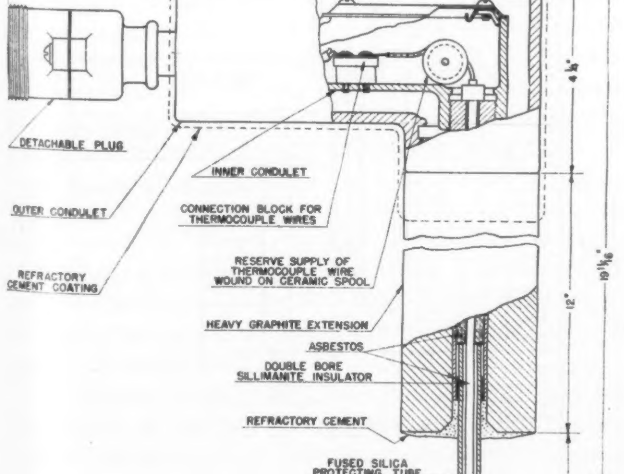
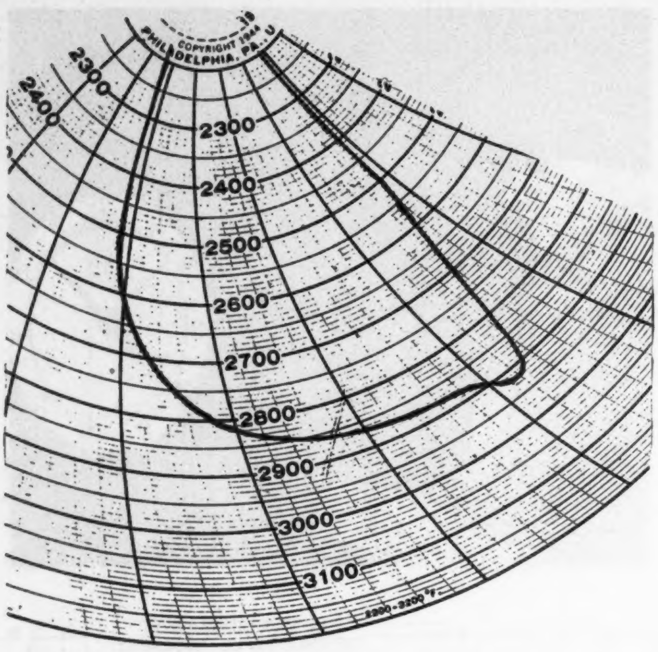


Fig. 10 (left)—Drawing showing the construction details and materials for an immersion head thermocouple.

about 6 to 10-min. intervals, a very complete log can be obtained by drawing a curve connecting these points.

The maintenance of this instrument appears from the results obtained to date, to be low, usually confined to replacement of the pyrex glass window which occasionally gets splattered with metal. Although a coating of metal and slag frequently adheres to the tube when withdrawn from the furnace, no difficulties have been encountered in rapidly removing the same.

Immersion Thermocouple Method. The second instrument selected for this investigation is a direct reading platinum-platinum-rhodium immersion thermocouple. This instrument is used in an adaptation of the so-called "quick-immersion" technique first developed by Schofield and Grace in England and later modified by other investigators in this country.



It consists of three main parts, namely, an angle type immersion head, an extension pipe fitted with a handle and the recorder, Fig. 9.

The immersion head shown in Fig. 10 contains a fused silica protection tube which comes in direct contact with the molten metal and acts as a protection for the hot junction of a platinum versus platinum—13 per cent rhodium thermocouple. The silica tube is attached to a heavy graphite extension block which acts as a protection at the slag line for the platinum leads which in turn are mounted in a double bore sillimanite insulator.

This graphite block is threaded to an 18-8 pipe screwed into an inner condulet, housing, a ceramic spool and a connecting block for the thermocouple wires. Although the required length of the wires is only about 20 in., a 30-in. thermocouple is used with the excess wire being coiled around the ceramic spool as a reserve. An outer condulet fitted with a detachable plug and coated with a refractory cement acts as a protection for the inner assembly.

The extension pipe, Fig. 11, which carries the lead wires and varies in length depending upon the furnace used, is protected by a 2-in. pipe fitted with rockwool at the end exposed to the furnace temperatures to prevent warping and damage to the wires.

The opposite end is fitted with a "quick-disconnect" locking type detachable plug for connecting the flexible rubber insulated wires leading to the recorder.

Taking Temperature Readings

The recorder, Fig. 12, is an electronic potentiometer having a range of from 2200 to 3200° F and fitted with a circular chart making a complete revolution in 4 min. A selector switch which is mounted on the panel enables the operator to balance the recording instrument before each temperature reading.

To assure maximum accuracy, the power or fuel as the case may be, is shut off and the bath thoroughly rabbled, just prior to taking a temperature reading. The unit is then inserted in the furnace by sliding it on the breast with the immersion head in the horizontal position, an operation easily performed by one man. The head is usually held for a few seconds above the slag for preheating whereupon the tip is rapidly immersed in the metal to a depth of about six in. As soon as the temperature curve levels off, a matter of 35 to 40 sec., the unit is removed from the furnace.

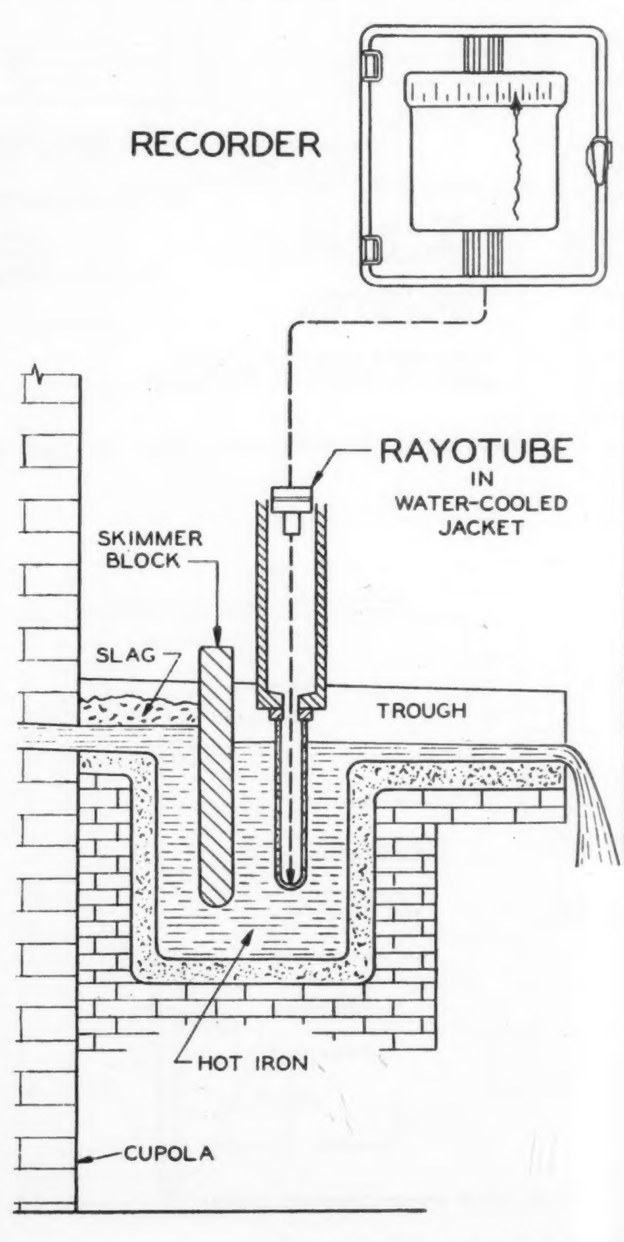
A typical reading is shown in Fig. 13. The sharp rise in temperature occurring at the end of the reading is caused by the couple passing through the hot slag when withdrawn and indicates the extreme sensitivity of this instrument.

Before taking a new reading it is best to replace the silica tube, although it is possible to obtain several readings on the same tube but always at the risk of losing a portion of the platinum wires.

The thermocouple which is calibrated with a stand-

Fig. 13 (left)—Typical temperature curve for thermocouple unit; 35 to 40 sec. required for curve to level off.

Fig. 14 (below)—Radiation type of pyrometer, permanently mounted, records temperatures for entire heat.



ard couple before being put into operation, is generally used for about ten readings after which time approximately one-fourth inch is removed and the wires rewelded at the hot junction and the entire couple annealed. After about 275 to 300 readings, or when the leads become too short, the thermocouple is replaced.

The accuracy of the instrument is within 10 to 15° at 2900° F and is dependent upon care in the assembly and replacement of the hot junction at proper intervals.

Evaluation of Results Obtained. In evaluating the results obtained from the rather extensive investigation carried out, we believe that we are justified in stating that both principles involved form the basis for very valuable tools which when properly handled can be a great help to the metallurgist in the foundry and in the mill.

Common to both are accuracy, reliability and ease in handling which are all necessary if the expenditure is to be justified.

Certain advantages and disadvantages, depending upon the application and requirements, are, however, inherent in each principle and these must be carefully considered when selecting the method most suitable for a particular shop.

When a complete time-temperature log from meltdown to tap is desired, an instrument based on the radiation principle offers the most in that it permits frequent readings, i.e., at about 6 to 10- min. intervals, to be taken. Such an instrument, furthermore, requires little maintenance. In addition, there is little danger of damage when adverse slag conditions are encountered.

Possible Sources of Error

Offsetting these advantages, however, is the fact that an instrument of this type is not standardized under operating conditions, therefore, slight errors are possible due to the difference in emissivity between the standardizing body and the molten metal as well as to the chilling effect and oxidizing effect of the air stream. However, by repeated checking against thermocouple readings, these errors have been found not to exceed about $\pm 10°$ F at 2900° F provided that the necessary care in the operation is exercised. Such errors are within acceptable limits.

Where maximum flexibility is of prime importance and the instrument is to be used for temperature recordings of the metal in the ladle as well as in the furnace, the thermocouple principle permits easier handling and has the advantage that the actual temperature is recorded without requiring emissivity correction.

Offseting this, however, is the need for replacing the silica protection tube after each reading at a cost of approximately $0.90 to $1.00 plus labor. This expenditure, which is rather high in particular when small furnaces are used, cannot be evaluated properly, however, without considering the much lower initial installation cost of the instrument.

Application in the Gray Iron Foundry. Of particular interest to the men in the foundries is the application of radiation type pyrometers. The operation of both these instruments is similar in that they sight a radiamatic or radiation tube into an enclosed protection tube, submerged in the molten metal.

The protection tubes are purged with a small amount

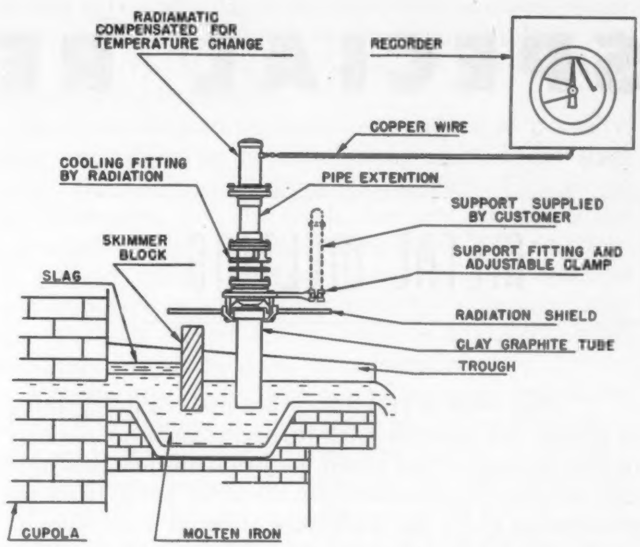


Fig. 15—Drawing showing construction details and application method of another type radiation pyrometer.

of air to free them from fumes that would impair true temperature readings. Also a suitable cooling system is provided to insure protection for the radiation collector units. The instruments are mounted permanently on continuous cupolas as shown in Fig. 14 and produce a complete temperature record for the entire heat.

Complete temperature records are a great aid to the foundryman in that they help to improve his cupola control and thereby the quality of his castings.

Although the writers have had no first hand experience with these units, it is our intention to investigate their usefulness in the immediate future in connection with all types of melting units used in the foundry.

Conclusions

Accurate determination of liquid metal temperatures is essential to control of melting operations. In general, temperature measuring instruments for foundry use must be accurate within approximately plus or minus 10° F at about 2900° F. These instruments must respond quickly to temperature changes, must be rugged but portable, and should have low initial and low maintenance costs. Operation should be simple and the instrument must be recording as well as direct reading.

This paper has been presented in an effort to highlight the developments in the field of molten metal temperature measurements and thereby stimulate further interest in a subject of vital importance to all foundrymen. It is our belief that no efforts should be spared in further developing and perfecting methods and instruments, as this will not only help to improve our understanding and control of metallurgical procedures, but in doing so will raise the quality of our work and thereby benefit the industry as a whole.

Acknowledgment

The authors wish to express their appreciation to the Leeds and Northrup Company of Philadelphia, Pa., the Brown Instrument Company, also of Philadelphia, and the Rustless Iron & Steel Corp., Baltimore, Md., for their permission to use some of the drawings and photographs appearing in the paper.

SPECIAL REFRACTORIES

METAL MELTING

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THE TERM REFRACTORIES has little or no meaning to people not familiar with furnaces. Such people may have some vague idea about fire brick but few probably ever saw one. Foundrymen, on the other hand, live with refractories every day and know them as a necessity to production. The operator probably gives them little thought, so long as production moves along smoothly. However, when trouble develops, he, and in turn his suppliers, become acutely conscious of the fact that refractories can present some difficult and tricky problems. Quick action is required to find the cause of the trouble and correct it. The discussions that follow are intended to assist the man in the foundry in understanding and dealing with any refractory problems he may encounter.

From the industrial point of view, refractory materials are those which meet a primary requirement of absence of softening by fusion at furnace temperatures. In addition they must invariably have those properties which enable them to resist destruction under one or more of the following conditions: corrosive slags, fluxes or furnace atmospheres, abrasion, heavy loading, and rapid temperature changes.

Classification of Refractories

Refractories may be classified in several ways and no one basis will serve all purposes. Simple classifications mentioned here for the purpose of illustration are (1) by chemical nature and (2) by source of raw material.

1. The classification by chemical nature may be shown as follows:

A. Acid refractories
B. Neutral refractories
C. Basic refractories

Acid Refractories are the most common and include fireclay, silica, zircon, and mullite refractories. The name "mullite" includes all refractories whose primary raw material is calcined kyanite, sillimanite or andalusite. The electric furnace product of this class is described as "synthetic mullite." Acid refractories are so named because of their high silica content, the principal acidic oxide.

The fireclay group includes low heat duty, intermediate heat duty, high heat duty, super duty and high alumina fireclay refractories. High alumina fireclay refractories are those containing over 47.5 per cent aluminum oxide and are classified as 50 per cent, 60 per cent, 70 per cent, and 80 per cent alumina. This distinguishes them from fused alumina brick which will normally contain from 87 to over 99 per cent aluminum oxide. Because of their chemical nature all of this group (except the 99 per cent alumina) react readily with basic slags and fluxes.

Disregarding the physical properties of the various bricks, reaction with basic slags is approximately in proportion to the refractoriness and the alumina content of the brick. Generally speaking, in the case of fireclay brick, the higher the alumina content, the higher the fusion point.

Silica bricks are next in importance to fireclay and make a valuable contribution to the foundry industry. Their outstanding properties are high fusion point and high load bearing capacity which make them suitable for furnace roofs. Being comparatively porous they do not readily withstand the action of highly fluid slags. Consequently care and judgment must be used where there is probability of slag action. Also due to their physical characteristics they are not suitable for periodic furnaces where thermal shock may be encountered.

Neutral Refractories

The most common neutral refractories are graphite, chrome ore, and alumina. They are considered neutral because they do not readily react chemically to form compounds with either silica or bases. Strictly speaking, silicon carbide may fall within this group, although due to oxidation and the type of bonds used, it behaves as an acid refractory in most instances.

Of all refractories, graphite is probably the least reactive. Liquid silicates do not wet it and thus it will not react with them. Its use, however, is confined to metallurgical applications in which the process of oxidation can be controlled.

Basic Refractories

Refractories of a basic chemical nature are of considerable importance for furnace linings where basic slags are encountered, as in the open hearth steel industry and in non-ferrous metallurgy. Where basic slags are used it is generally desirable to use basic refractories in contact with them. Magnesite, chrome-magnesite, forsterite refractories, dead burned magnesite, burned dolomite and basic clinker in granular form are the chief basic materials. Due to their high coefficient of expansion and susceptibility to thermal shock considerable care must be exercised in the use of the above refractories. They are in general not suitable for periodic or intermittent operations.

Electrically fused magnesia products and magnesia-alumina spinel likewise are in this group. Table 1 gives comparative data on the physical properties of most acid, basic and neutral refractories.

Classification by source of raw material, previously referred to, may be briefly shown in the following order:

A. Naturally Occurring Minerals

1. Fireclay
2. Silica
3. Chrome
4. Magnesite
5. Forsterite (from Olivine)
6. Kyanite, Sillimanite and Andalusite
7. Zircon

The most important materials of this group have been previously discussed under chemical classification.

B. Synthetic Fused Materials

1. Silicon Carbide
2. Fused Alumina
3. Fused Magnesia
4. Fused Mullite
5. Magnesia-alumina spinel

The differences that distinguish naturally occurring raw materials from raw materials made in the electric furnaces are explained in terms of crystal development and strength of the respective substances (Fig. 1).

Electric furnace materials have a completely developed crystal structure whereas in calcined naturally occurring minerals, crystal development may be limited. Calcination often has as its main purpose the removal of water of crystallization and reduction in shrinkage. In the electric furnace, minerals in their strongest and densest crystalline form are produced, and some purification may be accomplished. Because of their density, these materials show little or no shrinkage after manufacture into bonded shapes.

Failure Due to Slagging

In general most refractory failures can be attributed to slagging, abrasion, fusion and spalling.

Slag action is the result of chemical recation between the slag or fluxes and the refractory. This can be greatly influenced by the composition and viscosity of the slag, the density of the refractory, temperature and the chemical nature of the refractory, i.e., acidic or basic.

When slags are composed of highly reactive materials such as soda, potash, lime and iron oxide, slag action is accelerated. To get the longest life from refractories it should be the aim of every furnace operator to keep as well balanced a slag as possible. This of course is not always possible as the operator is often unable to predict what type of slag will be formed in a particular metallurgical operation.

Since all refractories have some degree of porosity, they are subject to penetration by slags. Fluid slags penetrate more readily than viscous slags. This action causes erosion, with the result that new surfaces of the refractory are continuously being exposed to reaction. In general, where temperature and chemical reaction are not severe, this action can be reduced by increasing the density of the refractory. There is, however, a limit to which this can be done economically.

A progressive decrease in rate of corrosion may occur if reaction balance is established by the cooling effect of increased heat loss through the thinner wall. This will decrease the rate of erosion by the slag and a relatively small reduction in temperature (as little as 50 F) will often materially reduce the action of the slag upon the lining. This has led to some interesting studies on the effect of insulation on furnace life.

Reducing Atmosphere

Slagging of refractories is often aggravated by a reducing atmosphere in metal melting furnaces. Ferrous oxide in the refractory, formed by the reduction of ferric oxide, accelerates the destruction of the refractory by slagging. Use of refractories of lower iron content will minimize this hazard.

Flame impingement is another common cause of excessive slagging. When the flame is permitted to impinge directly on the refractory, where slag is present, the elevated temperature will accelerate chemical reaction. Care in firing any furnace will contribute to longer refractory life.

Abrasion is the wearing away of refractory surfaces by the scouring action of moving solids. Tests have indicated that high strength refractories in general possess the greatest abrasion resistance. The abrasion resistance of the refractory in service decreases with higher operating furnace temperatures which soften the refractory.

The factors influencing abrasion are speed, pressure, angle of impact, and nature of the abrading fuel bed and charge as it moves against the furnace wall. The velocity and entrained solids in the flue gases are also important. Improper or careless use of cleaning tools and improper or careless charging of heavy pieces into the furnace must be avoided. Thickness and type of cement used in the joints must be watched.

Fig. 1—Products of the electric furnace shown in lump form. Left to right: Silicon carbide, fused alumina of 95 per cent purity, fused alumina of 99.5 per cent purity.

TABLE I
PROPERTIES OF REFRACTORIES

	Type of Brick	Composition	P.C.E. or Fusion Point	True Specific Gravity	Approx. Weight in lbs. 9" Brick	Linear Coefficient of Expansion per °C	Thermal Conductivity BTU/Hr./-Sq.Ft./In./°F.*	Mean Specific Heat (cgs)	Deformation Under Load 25#/sq. in.	Constancy of Volume	Remarks
ACID	Silica	SiO_2 95–96%	31–33 Cone	2.3–2.4	6	See (A) Below	13.0 390–1832°F	0.265 70–1832°F	No deformation at 2732°F, 50psi	Low Shrinkage. Rev.† exp. to Melting Point	Strongly resistant to acid slags. Readily attacked by basic materials and fluorides.
	High Heat Duty Fire Brick	Al_2O_3 35–42% SiO_2 52–60%	31–33 Cone	2.60–2.70	7½–8	53 x 10 $^{-7}$ 20 – 1200°C	400–2400°F 9.5	0.26 70°–1830°F	4.0+% @ 2460°F	2.0% Shrink. @ 2550°F	Rapidly attacked by basic slags, particularly iron slags. Moderately resistant to acid slags.
	Super Duty Fire Brick	Al_2O_3 43–44% SiO_2 51–53%	33–34 Cone	2.65–2.75	7½–8	53 x 10 $^{-7}$ 20 – 1200°C	Approx. same as High Heat Duty	Approx. same as High Heat Duty	2.5 to 4.0% @ 2460°F	1% Max. Shrink. at 2732°F	
	High Alumina Fire Brick	Al_2O_3 50–80%	34–39 Cone	2.80–3.40	8–9	53 – 65 x 10 $^{-7}$ 20 – 1425°C	Slightly more than High Heat Duty	Approx. same as High Heat Duty	Approx. same as Super Duty	0–3% Shrink. @ 2912°F	More resistant to alkali slags than fire clay brick; readily attacked by iron slags.
	Kaolin	Al_2O_3 44–45% SiO_2 51–53%	31–34 Cone	2.60	7½–8	53 x 10 $^{-7}$ 20 – 1425°C	13.5 @2400°F	0.254 480–1832°F	1% @ 2800°F	0.5% Shrinkage @ 3000°F	Slightly more resistant than fire brick to slags, particularly basic slags.
	Mullite	Al_2O_3 62% SiO_2 38%	38 Cone	3.03	8½	45 x 10 $^{-7}$ 20 – 1320°C	8.5 200–2600°F	0.175 70°–1475°F	0 @ 2650°F., 50 psi: 2.0% @ 3000°F, 50 psi	No appreciable change to 3000°F	Low solubility in glasses and some slags. Attacked by high iron slags.
	Zircon	ZrO_2 67.1% SiO_2 32.9%	approx. 4400°F	4.6	12	42 x 10 $^{-7}$ 20 – 1550°C	13.5 390°–1832°F	0.132 100°F	Fails @ 2820°–2910°F	No appreciable change to 2820°F	Not readily attacked by acid slags. Readily attacked by basic slags and fluorides.
	Silicon Carbide	SiC 89–91%	dissoc. @4082°F	3.13–3.22	9.5	45 x 10 $^{-7}$ 20 – 1100°C	66.0 @2000°F	0.186 70–1832°F	No deformation to 2732°F, 50 psi	No Shrinkage to 2732°F	Readily attacked by strongly basic slags, particularly those high in iron or calcium oxides.
NEUTRAL	Graphite	C 100%	above 5432°F	2.25	8	20 x 10 $^{-7}$ 20 – 1000°C	220. @ 2000°F	0.29 70–1832°F	None	No Shrinkage	Strongly resistant to all slags except those containing oxides readily reduced.
	Chrome	Cr_2O_3 30–45% Al_2O_3 15–33% SiO_2 11–17% FeO 3–6%	3550–4000°F	3.8–4.1	11	80 x 10 $^{-7}$ 20 – 1000°C	12.1 @2400°F	0.22 @ 1832°F	No deformation @ 2600°F	1.3% Shrinkage at 2820°F	Neutral properties. Not readily attacked by acid or basic slags.
	Fused Alumina	Al_2O_3 90–99.1%	38–41 Cone	3.80–4.00	11	70 x 10 $^{-7}$ 20 – 1000°C	18.0–20.0 @ 2000°F	0.174–0.304 32°–1832°F	1–2% @ 2732°F, 50 psi	No Shrinkage at 2732°F	Very resistant to acid slags, moderately resistant to basic slags; tendency to absorb.
BASIC	Forsterite	MgO 57.3% SiO_2 42.7%	40 Cone	3.3–3.4	9	110 x 10 $^{-7}$ 20 – 1500°C	10.3 @ 2400°F	0.22 70–200°F	No deformation to 2732°F, 50 psi	Negligible Shrinkage to 3000°F	Not readily attacked by basic slags; readily attacked by acid slags.
	Magnesia-Alumina Spinel	MgO 28.2% Al_2O_3 71.8%	3875°F	3.6	10	80 x 10 $^{-7}$ 20 – 800°C	14.5 @ 2400°F	0.25 70–1832°F			Moderate resistance to basic slags; low resistance to acid slags. Magnesia spinel sometimes shows slag absorption.
	Magnesite (Dead Burned)	MgO 83–93% Fe_2O_3 2–7%	3992°F	3.4–3.6	9½	147 x 10 $^{-7}$ 20 – 1425°C	13. 2400°F	0.278 70–1832°F	Poor load bearing property above 2450°F	No Shrinkage below 2900°F	Not readily attacked by basic slags; readily attacked by acid slags.
	Magnesia (Electrically fused)	MgO 94–96% SiO_2 2–3% CaO 1–2%	3992–4532°F	3.60	10	150 x 10 $^{-7}$, 20 – 1475°C	20.0 2000°F	0.292 32–2375°F	Poor load bearing property above 2732°F	Less than 1% below 3250°F	

* To change BTU units to C.G.S. units divide by 2903

(A) 430 x 10 $^{-7}$, 20 - 300°C, 30 x 10 $^{-7}$, 300 - 1100°C.

† Reversible

Fusion or softening is not a common type of failure but is one which can cause serious troubles. It is often the result of improper selection of refractory. It frequently comes with high localized temperature on piers, sidewalls and roofs due to flame impingement. Loading beyond the safe limits for a refractory at a given temperature may cause failure by plastic flow. This generally occurs in arches and locations where high stresses prevail. In structural design load test data for the specific refractory should be considered, and an ample safety factor should be allowed.

Softening can also be caused by penetration of materials such as fluid slags which, by reaction, reduce the fusion point of the refractory. This is sometimes caused by reducing atmospheres, and can be avoided by using refractories of lower iron content or higher density.

Stress Conditions in Spalling

Spalling is a word that applies to stone-like or low-tensile strength mineral substances meaning "to break up into chips, chunks, or fragments." This term adequately describes a type of failure that may be encountered in using refractories. It results when these brittle materials rupture instead of buckling, bending, stretching, or otherwise yielding under sudden or severe stress. The stresses that cause spalling in refractories develop through one or both of the following conditions encountered in practice:

1. Unequal or differential thermal expansion or contraction of a refractory.
2. Unequal mechanical loading, or localized overloading.

In the case of spalling due to unequal thermal expansion and the resultant thermal stresses a brittle refractory of low-tensile and higher-compressive strength breaks up rather than deforms under the (irresistible) unequal expansion or contraction following sudden localized heating or cooling. If one face of a body is suddenly heated faster than another, the heated part expands rapidly and tries to bend or stretch from the part that expands slowly or only a little. The same occurs during contraction on sudden unequal cooling. When this differential expansion or contraction is extreme, the resulting stresses will cause the refractory to fail just as though it had been fractured with a hammer and chisel.

If the piece broken loose has been carrying a critical mechanical load, its absence may cause overloading of adjacent parts and thereby cause more or less progressive mechanical failure. Unfortunately, when a piece spalls off, it presents a new face of the refractory which is subjected to the same stresses developed by severe local heating or cooling, for example, flame impingement or sudden introduction of a cold charge.

Thermal Expansion and Conductivity

Consideration of two physical properties of solids assists in making better selection of refractories to combat and minimize thermal spalling or heat shock. These physical properties are thermal expansion and thermal conductivity.

By using refractories having a low coefficient of thermal expansion the difference in expansion and resultant stresses when subject to unequal heating will be minimized. Fused silica for example has an extremely low coefficient of expansion; consequently, it can be quenched in water from white heat without spalling or fracturing.

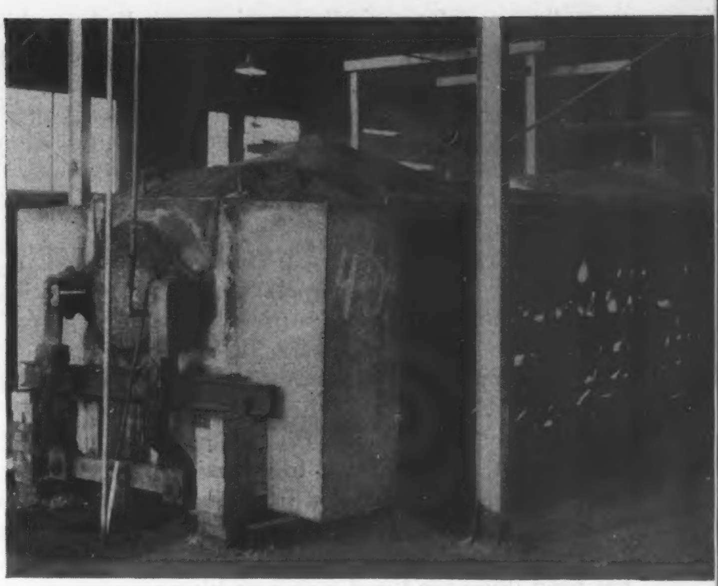

Fig. 2 — Resistance furnace producing silicon carbide.

By using refractories of high thermal conductivity local heating may be equalized quickly and the stresses of differential expansion will be minimized.

The refractory in a furnace may undergo a change in the coefficient of thermal expansion or heat conductivity so as to cause spalling. These alterations in physical properties may be caused by such unfortunate conditions as slag penetrations, vitrification and shrinkage due to overheating or reaction with fluxes. Improper insulation can contribute to these changes. When slag penetrates a porous refractory or when fluxes or overheating cause vitrification (development of glassy texture) in the exposed portion of a refractory, the physical properties of the thus modified mass may be different from those of the original material which remains in the unexposed part of the refractory. Differentials in expansion, conductivity, and mechanical loading are all conducive to spalling.

Slag Penetration

When spalling occurs due to slag penetration new refractory faces are presented for further penetration by slag. Thus a vicious progression of penetration and spalling can rapidly destroy a refractory structure. Barring and cleaning of slagged surfaces should be done carefully.

Spalling due to localized overloading is one wherein a brittle refractory is pinched or subjected to bending stresses through improper furnace maintenance, construction or design. Sometimes the rupture of the refractory is caused by inadequate expansion joints in areas having greatest expansion. Arches, skews, jambs, and keys often exhibit this type of spalling, frequently due to improper alignment in construction and the difficulty of loading these members uniformly.

The term "special refractories" has been selected to designate those refractories whose basic raw materials have been synthesized or fused in electric furnaces. The

term "super refractories" sometimes applied to this group of refractories, by implication, imposes an unfair burden on them. Super suggests that they are the ultimate in refractories for all applications. Actually their use is limited to those instances where they can demonstrate an economic advantage. They cannot be recommended as a "cure all" for the foundryman's refractory problems.

However, it has been clearly shown that these materials extend the range of operations in many difficult fields and have wide possibilities yet to be exploited. Although the use of these refractories has been limited, there are ample indications that further study and trial should prove beneficial to the foundry industry.

"Special refractories" refers to that group whose chief constitutent is one of the following electric furnace products: fused alumina, silicon carbide, fused magnesia, and synthetic mullite. These are the best known and more common ones. Others upon which some work has been done are fused stabilized zirconia, magnesia-alumina spinel, fused beryllium oxide and fused thorium oxide. Because of their present high cost and industry's limited knowledge of their properties, it is doubtful if this latter group will be of immediate interest in the foundry field.

Production of Silicon Carbide

Silicon carbide is produced in a resistance type electric furnace from an intimate mixture of silica sand, coke and sawdust (Fig. 2). The mixture is placed around a graphite core through which the electric current passes, heating the charge to the reaction temperature. Large quantities of gas are envolved and the sawdust gives porosity to the mass providing an escape for the gasses. When a furnace run is completed, a core of silicon carbide remains, surrounded by a mass of unconverted material.

Fused alumina is produced in a direct arc type furnace and is usually a periodic operation (Fig. 3). Bauxite or alumina concentrates are fused to a molten mass and allowed to crystallize in the furnace. Two grades of fused alumina are produced; one from bauxite containing approximately 96 per cent alumina with small percentages of iron, silica and titania, and a purer grade containing 99.5 per cent alumina, with the balance consisting of soda, silica and iron.

Fig. 3—Direct arc furnace producing fused alumina or fused magnesia. This usually is a periodic operation.

Fused magnesia may be prepared from calcined magnesite or sea-water magnesia. This is also prepared in the direct-arc type furnace by the same method employed for alumina.

Synthetic mullite is usually produced in the same type of direct arc furnace, from naturally occurring minerals such as bauxite, diaspore clay and silica mixed to give the proper composition.

Silicon Carbide Refractories

Of the special refractory materials, silicon carbide is probably the most widely used in the foundry field in the form of bonded-and-fired bricks or shapes and refractory cements.

Silicon carbide bricks and shapes are used for lining:

1. Crucible melting furnaces, stationary, tilting, crucible and pit type. They are also used for covers for these furnaces.

2. Copper alloy melting and scrap refining furnaces, reverberatory, cupola and open-flame types.

3. Aluminum melting furnaces, reverberatory, crucible melting or metal pot types.

4. Combustion zone in air furnaces.

Silicon carbide refractories also find use in the foundry field in crucibles for non-ferrous melting, fabricated muffles for large malleable annealing furnaces, and slag hole blocks for gray iron and malleable operations.

Silicon carbide tubes for recuperators in the metal industry are well known. Considerable work has also been done on the use of internally-fired silicon-carbide tubes as sources of radiant heat for annealing and heat treating furnaces. These are intended for use in that temperature range which is too high for heat resistant alloy tubes. The results have been encouraging and at least one company is offering furnaces incorporating this design and others are considering this application.

Silicon carbide slag hole blocks are widely used, especially in back-slagging cupolas. Comparatively speaking, where clay blocks give one hour or more of service, silicon carbide blocks will consistently serve from one 8-hr to three 10-hr shifts before replacement is necessary. Conditions of operation affect the life of silicon carbide and highly basic slags tend to shorten the life of the block. Since molten metal flowing through slag hole blocks will rapidly erode them, metal contact should be avoided as much as possible.

Silicon carbide door jambs and lintels are used in direct arc type furnaces, in many instances supplementing the usual lining and reducing wear in this area.

Cements containing silicon carbide are used for:

1. Rammed linings and patching in open flame furnaces melting non-ferrous metals.

2. Rammed linings and patching in all types of crucible melting furnaces.

3. Patching cement in non-ferrous scrap refining furnaces at the slag line.

4. Patching cement for malleable air furnaces at the slag line just above the metal.

They have a wide range of application and probably constitute the largest single usage of silicon carbide in the foundry trade.

Silicon carbide grain, formerly known as fire sand and lower in silicon carbide content than that used in bonded shapes or bricks and cements, was sold in large quantities to the foundries who created their own refractory cements by the addition of a plastic clay for bond. Some of these mixtures often showed outstanding qualities and seriously confounded the refractories engineer who tried to replace them with one of his own prepared cements. Silicon carbide grain is still available for this use but is now sold under other designations. It is of higher quality than the fire sand and commands a higher price. During the war, necessity required the withdrawal of fire sand from the market in support of the industry's effort to meet the ever increasing demand for more silicon carbide.

Many crucibles of the so-called clay graphite type contain appreciable quantities of silicon carbide grain as a primary ingredient with decided benefits.

Fused Alumina Refractories

Fused alumina refractories, composed of fused alumina grain, bonded into bricks or shapes with a suitable type and quantity of ceramic bond have found little use in foundry practice. However, when used for special applications, they have given good service.

Large fabricated muffles for anealing castings to protect the work from the products of combustion and flame impingement have given excellent service.

Solid rings as well as segmental linings have been successfully installed in gas and oil-fired crucible melting furnaces. Segmental covers of this material have been tried but usually fail due to thermal shock.

Burner tunnels and burner blocks for melting furnaces have been supplied in fused alumina.

Pouring spouts and tubes for precision casting of heat resistant alloys have also been successfully used.

In one case where high conductivity copper was being melted in an indirect arc furnace, trouble from silicon pick up in the melt was encountered while using an aluminum silicate lining, necessitating the scrapping of a number of melts. By installing a fused alumina brick lining, silicon pick up was eliminated and a considerable saving was shown, without considering a 20 per cent increase in lining life. This was true in spite of the fact that the fused alumina lining cost twice as much as the one formerly used. In this case special fused alumina door jambs, lintels, and port blocks were also installed.

Fused alumina cements are a mixture of fused alumina plus a suitable clay bond, selected to mature satisfactorily within the temperature range of use. In most cements of this type, it is important to keep the percentage of bonding agent as low as practical and this

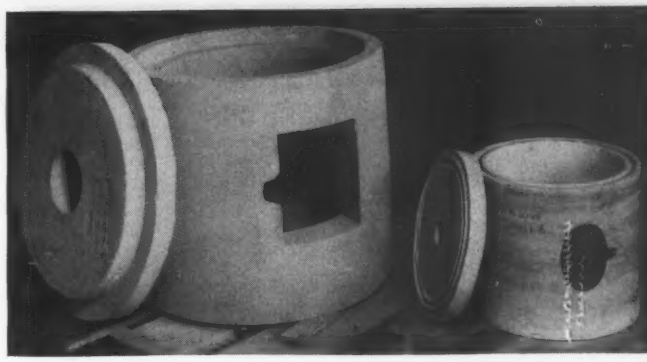

Fig. 4—Crock and cover linings for two sizes of furnace.

seldom exceeds 15 per cent by weight. Most applications of these cements are in the non-ferrous melting field.

Several fused alumina cements have been used successfully in the vertical ring induction furnace for melting yellow brass and a wide range of copper alloys such as nickel silver, gilding metal, leaded brasses and bronzes and many others.

It is also used as rammed linings and patching cements in the indirect arc type furnaces melting pure nickel and nickel alloys such as the (aluminum-nickel-cobalt) magnet metals and some heat resistant alloys.

In a test of a rammed fused alumina cement roof for a small direct arc furnace, melting 1000 lb of alloy steel per heat, encouraging results were obtained. With basic melting practice, the best previous roof had given seven heats, while the fused alumina cement roof gave an average of 45 heats. When the furnace was switched to acid practice, a life of 250 heats was obtained. So far, this is the best roof this foundry has found, indicating that further work should be done in this field.

Successful life has been reported when melting beryllium copper and manganese steels in high frequency

Fig. 5—Rammed cement lining surrounding secondary of a vertical ring induction furnace showing poor installation. Conditions shown in the photograph are variable thickness of layers, poor union of layers, and porous areas which allow penetration of the molten metal.

Fig. 6—Section of lining from lower left-hand side showing enlargement of slot from rectangular cross section of 3 in. x 1 in. to oval section 4 in. x 2½ in.

induction furnaces lined with fused alumina cements.

To a limited extent these cements have also been used as rammed-in linings in various types of gas-fired crucible melting furnaces, especially where high temperatures are consistently maintained.

Burner tunnels and burner blocks in metal melting furnaces are often rammed in place on the job using these cements. They may be installed for both gas or oil firing, being sufficiently refractory to withstand flame erosion satisfactorily.

The principal use of fused alumina grain in the foundry is for mold facings in the Durand process as described by J. H. Hall in patent No. 2144532. This grain is excess fines from the milling of fused alumina for abrasive purposes and is generally classified as "settling tank fines." Some of the larger foundries use several carloads a year. As described in the patent, the mold composition is 100 parts alumina, 13 parts hydraulic setting or Portland cement and 7 parts water. This is insufficient water to completely hydrate the cement and Durand describes the mixture as being "sub-hydrated." The mixture of alumina fines and cement is more refractory than the silica sand and Portland cement mixture comprising the balance of the mold. It reduces metal penetration of the mold at those points where this is a common source of trouble.

Some work has been done on the use of fused alumina fines as a core wash, and in one or two instances this application has been satisfactory.

Crucibles of clay bonded fused magnesia are available for high frequency induction melting in capacities up to 1000 lb. They may be used for melting various ferrous and non-ferrous alloys. Crucibles are seldom used in furnaces of over 500-lb capacity, since rammed-in linings have proven more practical in most cases.

Fused Magnesia Refractories

Small special linings of fused magnesia containing very small percentages of bond have been widely used in small indirect arc melting furnaces for precision casting heat resistant alloys of the high cobalt-nickel type (Fig. 4).

Larger indirect arc furnace linings of the so-called crock-and-cover type are available in fused magnesia. These range in size from 13 in. diameter by 13 in. long up to 20 in. diameter by 32 in. long (50 to 1100 lb).

Many of the fused magnesia cements contain fused alumina as well as fused magnesia, together with some suitable bonding agent, generally a small percentage of plastic clay. The percentage of fused alumina may vary considerably but seldom runs over 40 per cent (Figs. 5 and 6).

In the high frequency electric furnace, these cements are used for melting stainless steels, nickel-chromium alloys, alloy tool steel, etc. For small melts in laboratory furnaces, where contamination from a graphite crucible is of concern, a fine grained cement of this type is often used to line the crucible.

In the small indirect arc type furnaces these cements may be used as rammed-in linings when melting heat resistant alloys for precision casting.

In any discussion of refractories for foundry use, attention should be given to zircon and mullite refractories. Both are of considerable importance in the foundry field and their use has proven helpful in many troublesome melting problems.

Miscellaneous Special Refractories

Zircon bricks and shapes have been widely used in linings in aluminum melting furnaces. Zircon crucibles have proven useful, primarily in the melting of platinum and other precious metals.

Mullite refractory linings are widely used in indirect arc type furnaces for the melting of practically all types of non-ferrous alloys, stainless steels and heat resistant alloys.

For melting a wide variety of copper alloys in the vertical ring induction furnace mullite refractory cements have gained considerable usage in recent years. They are also used in many foundries for patching and lining crucible melting furnaces and open flame furnaces, for building up pouring spouts and for other miscellaneous uses.

By discussion of classifications and descriptions of refractory materials, their successful applications, and some of the factors entering into failures, an approach has been made to the evaluation of special refractories in the foundry.

Special refractories are just what the name implies. They are a special tool available to foundry operators and other furnace users for specific applications.

Due to the complexity of refractory failures in the foundry, collection of empirical data from field tests is still one of the best means to use in approaching a problem. An understanding of how and why failures occur, along with experience, will serve to analyze troubles and conduct tests. Few failures have a single cause. In most cases the cause will be a combination of factors woven into a complex pattern. Although failures have had considerable attention, the fact that much has been learned and that most progress has been made through successful application of refractories should not be overlooked.

Improvement in the life of any refractory installation may be achieved by careful selection of the product best suited to the job, proper installation, adequate maintenance provided at the time needed, protection from thermal shock, attention to the firing equipment and care to avoid damage in charging or cleaning.

GATING MAGNESIUM ALLOY CASTINGS

A NEW TECHNIQUE

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and
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THE PHYSICAL AND CHEMICAL CHARACTERISTICS of a casting alloy dictate to a great extent the means by which it must be gated and risered to secure satisfactory castings most economically. In some alloys, unusually high density or high melting point necessitate special and difficult techniques. In others, high affinity for and sensitivity to dissolved gases create a necessity for costly foundry methods. In magnesium alloys, the high chemical activity of the liquid metal has created special foundry problems.

Partial solution to these problems has come through development of gating techniques suited to the characteristics of the metal. The purpose of this paper is to present to the industry a new gating method by which some of the problems created by the chemical activity of liquid magnesium alloys have been overcome more economically than when using previously published gating methods.

Since liquid magnesium alloys react rapidly with the moisture and air in molds to form oxides, it is necessary to minimize gating turbulence and to prevent any turbulence from occurring within the casting cavity. For this reason, bottom-gating methods are used widely with these alloys. These methods have been discussed previously in the literature.[1]

In such methods, for the most part, the metal is first brought, in the gating, to the level of the lowest part of the casting cavity. Here it usually is filtered through skim gates or strainer cores; and then is caused to enter the casting cavity at its lowest extremities, and to rise without turbulence until the mold is full.

While bottom-gating methods are effective in preventing the inclusion of non-metallic films in the casting, they set up basically undesirable conditions for securing directional solidification. For this reason, gating systems have been sought which do not require all the metal to flow through the lower portions of the casting cavity.

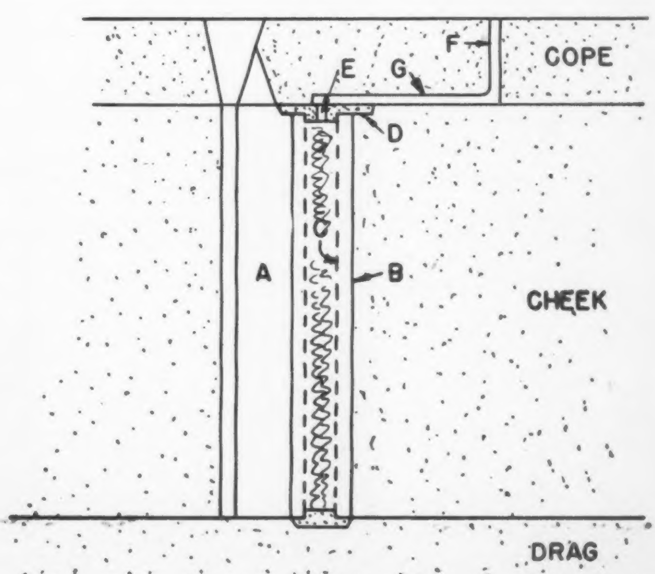
Beck[2] described a side-gating technique which has found considerable use in the casting of vertical-walled parts. Baker[3] has discussed other gating variations intended to secure soundness through controlled directional solidification, although his work dealt chiefly with relatively small, experimental castings.

In the casting of large vertical-walled parts, side-gating techniques represent a considerable advance over bottom gating. However, for reasons to be discussed the authors believe that conventional side-gating systems are not completely satisfactory as means of introducing magnesium alloys into molds.

The new gating system discussed here seems to provide more favorable mold-filling conditions. Not only are more favorable conditions for controlled directional solidification set up with this system, but castings of excellent freedom from included non-metallic aggregates result.

Basic features of the new gating system (sketched in Fig. 1) include a slot gate *(A)* which continuously connects the casting with the well *(B)*, as in the conventional side gating described by Beck.[2] An annular screen *(C)*, placed concentric with the well *(B)*, consists of a cylinder of tinned steel skim gate, commonly used in magnesium-alloy founding for filtering the metal stream. This cylinder is located at each end by cores placed as sketched in the drag and in the cope-cheek parting. A quantity of coarse steel wool is placed loosely inside the annular screen.

Fig. 1—Basic features of the new gating system. Letters shown in the drawing refer to description in text.



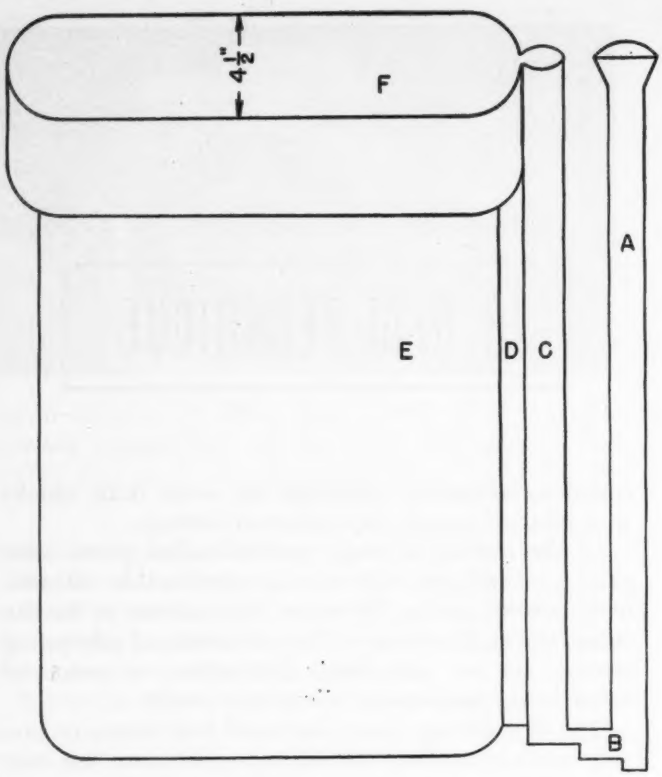


Fig. 2—Sketch showing the conventional side gate, first applied to the casting of a 24x24x3 in. rolling slab. A—Sprue. B—Screen pocket. C—Well. D—Slot gate. E—Casting. F—Riser.

Fig. 3—Photograph showing typical radiographic quality of 24x24x3 in. slabs cast with conventional side gate as in Fig. 2. Radiograph at left, taken through full 3-in. thickness; at right, 1-in. thick slices of slab; both radiographs reduced somewhat in reproduction.

The top end of the annular screen is located by the core *(D)* in the cope-cheek parting and through this core there is an orifice (E). The metal enters the mold through the sprue *(F)*, flows through the runner *(G)* to the orifice *(E)*, then drops through the annular screen containing steel wool, whence it flows through the slot gate into the casting cavity.

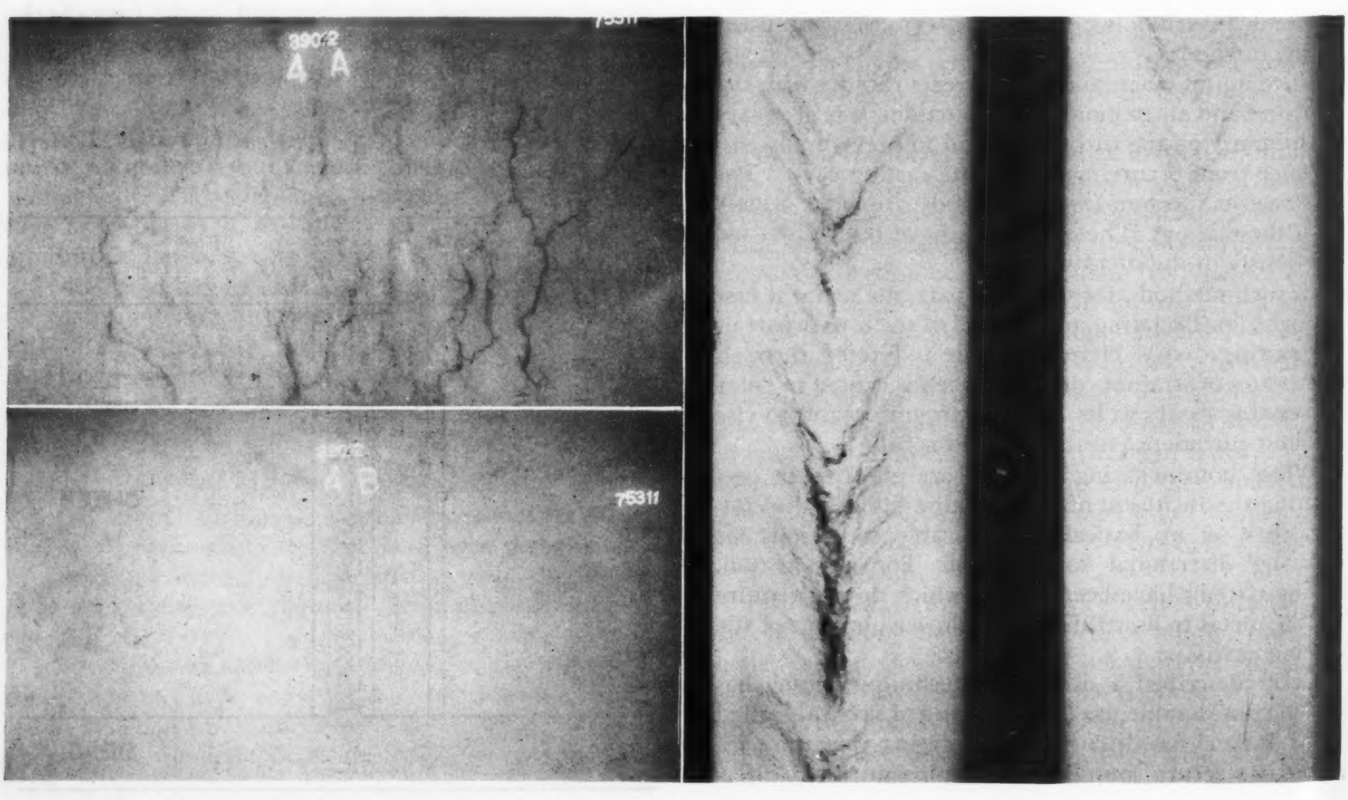
With this gating system, the flow of metal into the casting cavity is so controlled as to set up favorable thermal conditions for controlled directional solidification. The last metal poured (the hottest metal) comes to rest in the top risers, with little flow of metal through the lower portions of the casting cavity during the filling of the mold.

The annular screen serves to filter out any reaction-product skins which may form as the metal drops freely through the orifice down through the well. Thorough fracture tests of many castings made by this method indicate that this filtering action is effective in preventing such films or oxides from entering the casting cavity.

In early tests, the steel wool was not used inside the annular screen. As a result, the metal to some extent flowed through the upper part of the annular screen without first dropping and finding its level in the well. When this happened, the metal would run down the outside of the screen and the reaction products so formed would be washed into the casting cavity.

It was found that a small quantity of coarse steel wool in the annular screen prevented this type of flow. The metal stream followed the steel wool to the bottom of the well (or until it found its own level in the well), then flowed horizontally through the screen into the casting cavity.

The function of the orifice is primarily to direct the metal stream into the center of the annular screen, thus further insuring that the metal will not be forced



through the screen until it reaches its own level in the well. The orifice may also be used to control the pouring rate, although the sprue is more commonly designed to perform this function.

Other variations of this gating principle have been applied, as discussed later in this paper.

Experimental and Production Results

A—Cleanliness of Castings

The first casting poured with this gating method was a simple, vertical test panel. Fractures of a number of panels were consistently free of any indication of included skins or films of a non-metallic nature. Later evaluation of many other experimental and production castings confirmed this observation. It therefore was concluded that castings made by this method compare favorably in cleanliness with those made by any other method.

B—Quality of Castings

One of the first applications of this gating method was in the casting of an experimental rolling slab in a permanent mold. Attempts first were made to cast this shape by means of the conventional side gate sketched in Fig. 2. The radiographic appearance of the resulting slab is shown in Fig. 3.

After several attempts to obtain acceptable quality, the gating method sketched in Fig. 4 was employed and it was found that by pouring the metal slowly and directly down the well, the radiographic appearance shown in Fig. 5 resulted. Complete freedom from radiographically visible porosity thus was attained.

This was considered a convincing confirmation of the beliefs that initiated the study of this type of gating—namely, that more ideal filling conditions for directional solidification would result. In addition, the fracture quality of the slabs in which the new gate was

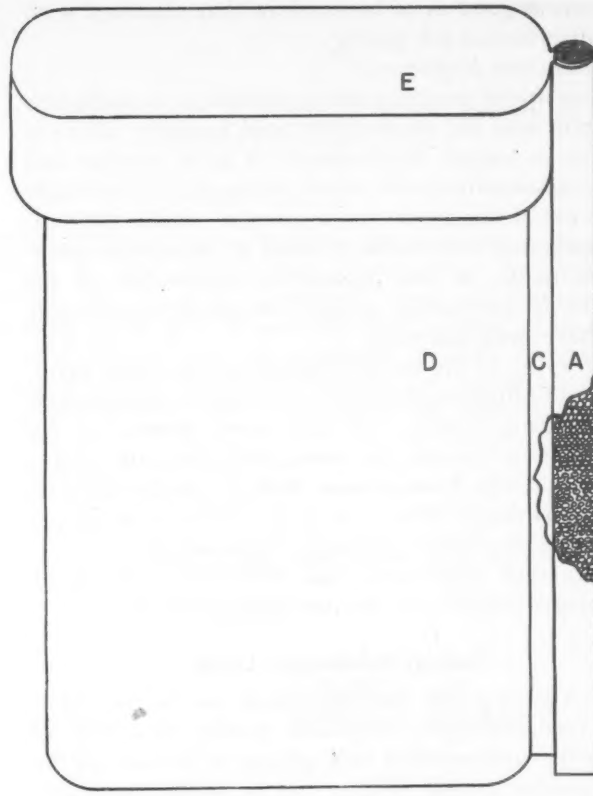
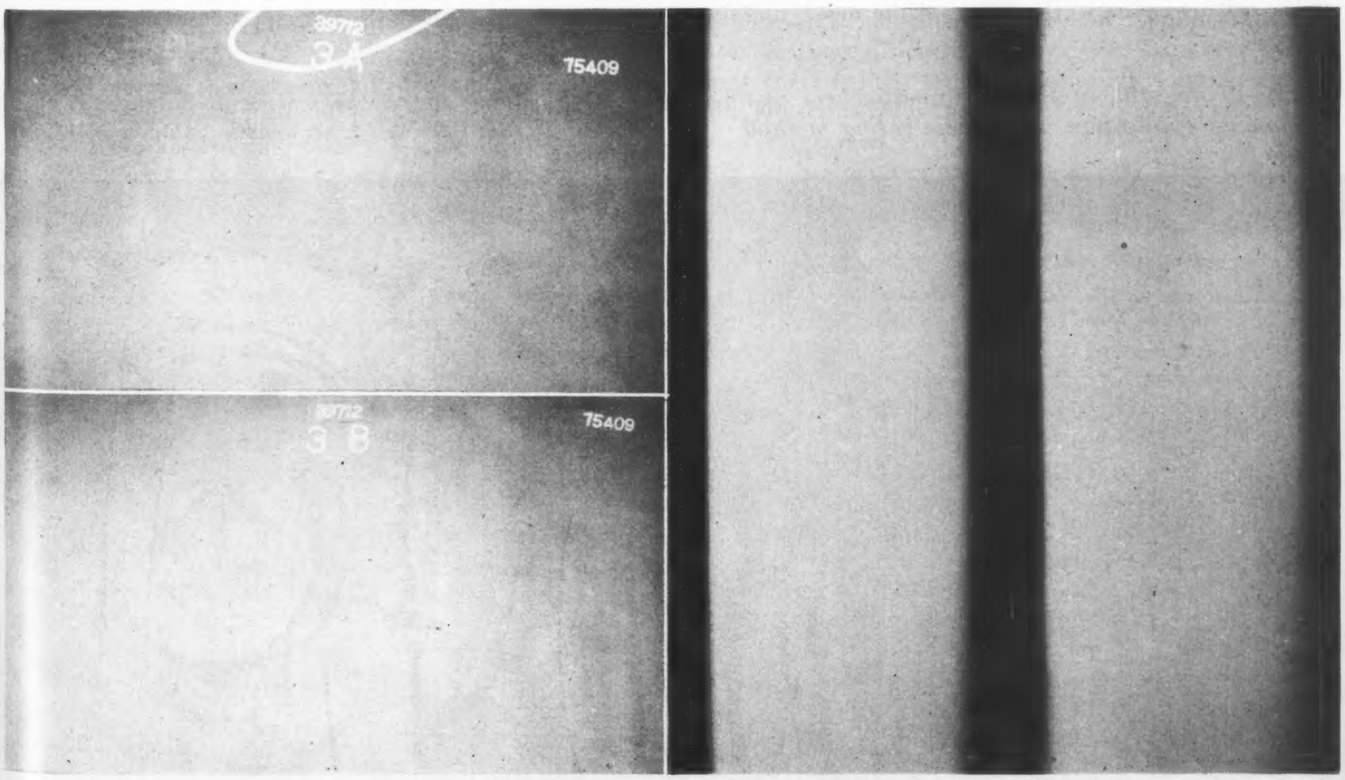


Fig. 4—Sketch showing application of the new gating method to the casting of a 24x24x3 in. rolling slab. A—Well. B—Annular screen. C—Slot gate. D—Casting. E—Riser.

Fig. 5—Photograph showing typical radiographic quality of 24x24x3 in. slabs cast with the new gating system as in Fig. 4. Radiograph at Left, taken through full 3-in. thickness of slab; at Right, 1-in. thick slices of slab; both reduced somewhat in reproduction.



used was as good as or better than that obtained with the conventional side gating.

C—Production Experience

These initial successes led to introduction of the new type gate into the production sand foundry, where it has seen its highest development. A great number and variety of aircraft-quality sand castings have been made by the use of this method. For purposes of this paper, it is not practical to describe in detail the numerous observations made, in this production experience, of the value of the new gating method. However, many economies have been achieved.

The value of the method hinges on the more favorable mold-filling conditions obtained than with conventional gating systems. All the metal poured is not forced to flow through the lower portions of the casting cavity, and the foundryman finds it much easier to avoid shrinkage defects such as draws and microporosity in the lower portions of the casting.

Production experience has indicated four major advantages inherent in the new gating system.

Foundry Advantages Listed

(1) A gating and risering system can be developed more readily to give acceptable quality in a new job than with conventional side gating or bottom gating. A successful gating system can be determined after fewer unsuccessful attempts.

In the experience of the authors, whereas previously it commonly required four or five attempts to find a suitable system for such parts as large aircraft wheels, more than two or three attempts now are rarely necessary when the new gate is applied. In one instance the new gate was successful on a large wheel after more than a dozen efforts had been made to secure satisfactory quality using conventional methods.

This advantage is attributed to prevention of the flow of large amounts of metal through the lower part of the casting cavity in the filling of the mold, thereby avoiding any local overheating of the mold materials.

(2) Fewer chills are required to secure soundness. In numerous jobs converted from conventional side gating to the new gating or some variation of it, it was found possible to eliminate many chills from the drag portions of the casting, without sacrifice of quality. This was accomplished without significant changes in the size, shape or position of feeders.

This observation indicates that with conventional side gating some chills are necessary to counteract the heating effect of the flow of metal through drag portions of the casting cavity. When a system is used which avoids such flow, the chills are no longer needed.

Uniform Quality Obtained

(3) Uniformity of quality from one casting to another is significantly increased. With conventional gating systems, random draws and random objectionable amounts of radiographic porosity are more common than with the new system. Even with simple test castings, the streaks of porosity associated with bottom gating are not found in the same location from one casting to another.

It is evident that the channelling of flow frequently is of random nature when much metal is caused to flow through the lower parts of the casting cavity. When this type of flow is avoided, a basic cause of the random occurrence of shrinkage defects is removed.

(4) Substitution of the new gating system for conventional methods almost invariably has resulted in increased casting yield (ratio of shipped weight to poured weight), without sacrifice of quality. Such increases in casting yield were possible because it no longer was necessary to use extreme riser sizes in an attempt to counteract the tendency toward random shrinkage defects caused by improper mold-filling conditions.

Early in the development of this gating method, an unusual opportunity for testing its value developed in

Fig. 6—Photograph of 110-in. aircraft wheel casting, showing application of the new gating method.

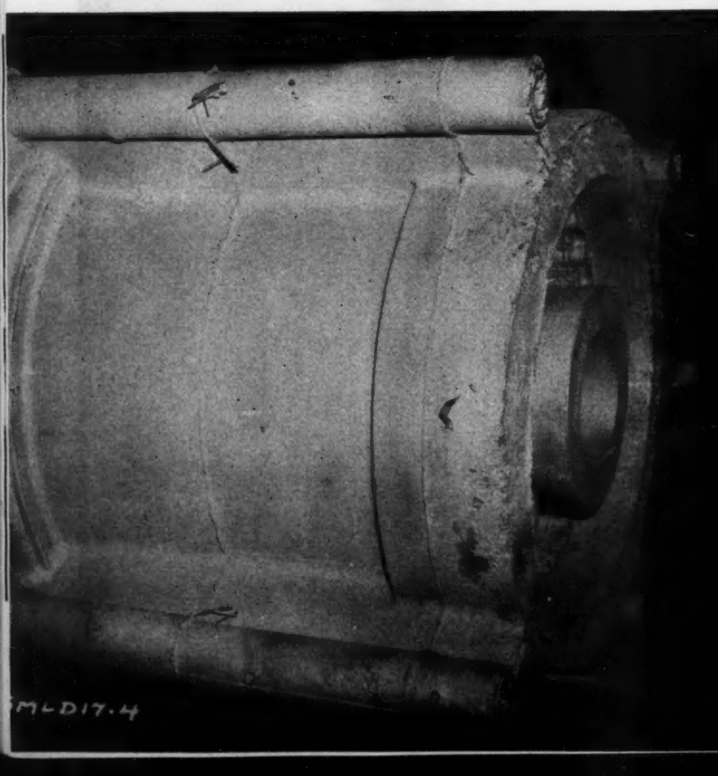


Fig. 7—Another view of the new gating system as applied to same 110-in. aircraft wheel casting shown in Fig. 6.

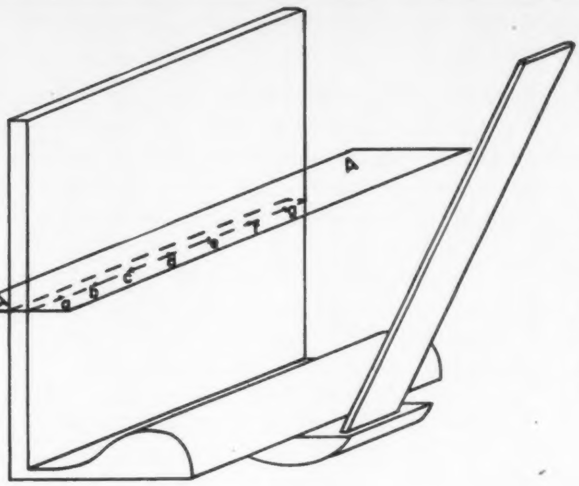
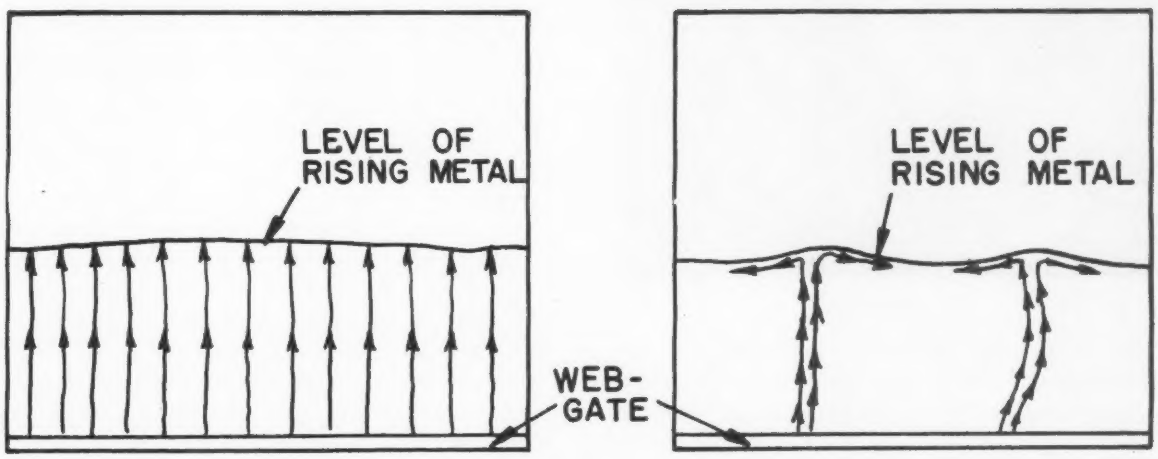


Fig. 8 (left)—Sketch of a vertical panel, bottom gated through a uniform web gate.

Fig. 9—Channelling of flow in bottom-gated castings. Idealized (left) and actual (right) flow conditions during the filling of a vertical panel bottom-gated through a web gate. While the same amount of metal flows, in theory, over each portion of mold material, actually most of the metal flows in a few random channels, overheating certain streaks of the mold surface.



the casting of a large landing wheel to be used experimentally on the B-36 bomber. The wheel had a shipped weight of approximately 830 lb and numerous attempts had been made to cast with conventional gating methods. Despite the most careful planning and utmost application of known principles, all attempts had failed to yield a production method which would insure satisfactory quality. The most serious sources of scrap were draws and radiographic microporosity.

The new gating method described here then was attempted, as photographed in Figs. 6 and 7. Draws were practically eliminated as a source of scrap, and much less microporosity appeared in resulting castings.

Magnesium Demands Minimum Turbulence

One of the foundryman's most fundamental controls over the quality of a casting lies in the manner in which the mold is filled with molten metal. The freedom of a casting from included non-metallic aggregates, and from a great variety of other internal and surface defects, is dependent to a great extent on how well the casting is gated. One requirement of a good gating system is that pouring turbulence be kept to a minimum. While this is a desirable attribute of the gating system for any alloy, it is essential in a gating system for a magnesium-alloy casting.

The reaction of liquid magnesium with air and water vapor necessitates the use of inhibitors in the molding sand. These inhibitors prevent burning of the metal by reacting with the metal to form protective films. Since the films which form during the pouring of magnesium-alloy castings differ little in density from the metal itself, there is little tendency for gravity segregation to separate them from the metal stream, once they have been intermixed.

In gating magnesium alloy castings, therefore, two precautions are necessary: (1) Turbulence in the gating system must be kept to a minimum to prevent entrainment of films in the metal stream; (2) turbulence cannot be permitted in the casting cavity itself.

These necessities have led to the use of bottom gating as the most general method for introducing magnesium alloys into molds. In these methods, the metal is first brought to the level of the lowest part of the casting cavity with as little turbulence as possible. Usually, the metal is filtered at this point by causing it to flow through skim gates or strainer cores, thus separating any entrained films from the metal stream. The clean metal then is introduced into the lowest parts of the casting cavity, and is allowed to flow upward.

It is important that the gating be so arranged that the metal does not drop from one level to an appreciably lower level within the casting cavity itself. When this happens, protective films form on the surfaces exposed by the resulting turbulence and tend to be entrapped in the casting.

Fig. 10—Method by which a 24x24x⅜-in. panel was bottom-gated through a uniform web gate.

These are the considerations that have dictated the use of bottom gating to so great an extent in the founding of magnesium-base alloys. Bottom-gating methods have proved highly successful in preventing the inclusion of non-metallic films in castings. Great quantities of aircraft-quality castings have been produced by these methods.

However, serious disadvantages are associated with bottom-gating techniques. One of these involves the point that all metal poured must flow through the lower portions of the casting cavity, with the result that the last metal poured (the hottest metal) comes to rest in the bottom of the casting cavity, while the metal poured first (consequently, the coldest metal) comes to rest in the top part of the casting cavity or in the risers.

Since top-risering often is necessary, this results in adverse conditions for directional solidification. Further, the mold material adjacent to the lower parts of the casting cavity is heated to a greater extent than that adjacent to the upper parts. This also is unfavorable to feeding with top-risers.

Metal Flow Tends to Channel

If this were the only disadvantage of flowing all the metal through the lower parts of the casting cavity, its bad effects still could be overcome without great difficulty by bottom feeding with blind risers. In many cases this can be and is done, especially when relatively thin sections are involved.

However, a still greater disadvantage of this type of mold-filling lies in the fact that the flowing metal tends to follow certain channels in filling the casting cavity. In a uniform vertical section, for example, gated as sketched in Fig. 8, the same amount of metal will not flow over each portion of the mold material intersected by the horizontal plane *A-A* and no uniform filling of the panel occurs such that the same quantity of hot metal will flow over each point *(a, b, c . . .)*. Instead, the flow tends to channel as sketched in Fig. 9.

The mold material is heated by the passage of metal over it, and naturally it is heated more in locations where channelling of flow occurs. Similar flow conditions exist in horizontal or inclined sections. In any case, the result is that some shrinkage defect is likely to appear where channelling occurred. Sometimes a streak of porosity occurs; in other cases, a shrink or draw type of defect occurs.

Multiple Gating Widely Used

Foundrymen have combatted this problem by multiple gating of magnesium-alloy castings. In any magnesium-alloy casting of appreciable size, it has long been recognized as good practice to gate into the casting cavity at numerous points. In this way it is attempted to prevent too large a volume of metal from flowing over any portion of the mold material. The use of a single gate into a large magnesium-alloy casting is almost never encountered.

The importance of this effect of channelling of flow may be visualized by studying Figs. 10 and 11. Figure 10 shows the method by which a 24x24x⅜ in. panel was gated and risered, employing a uniform web gate along

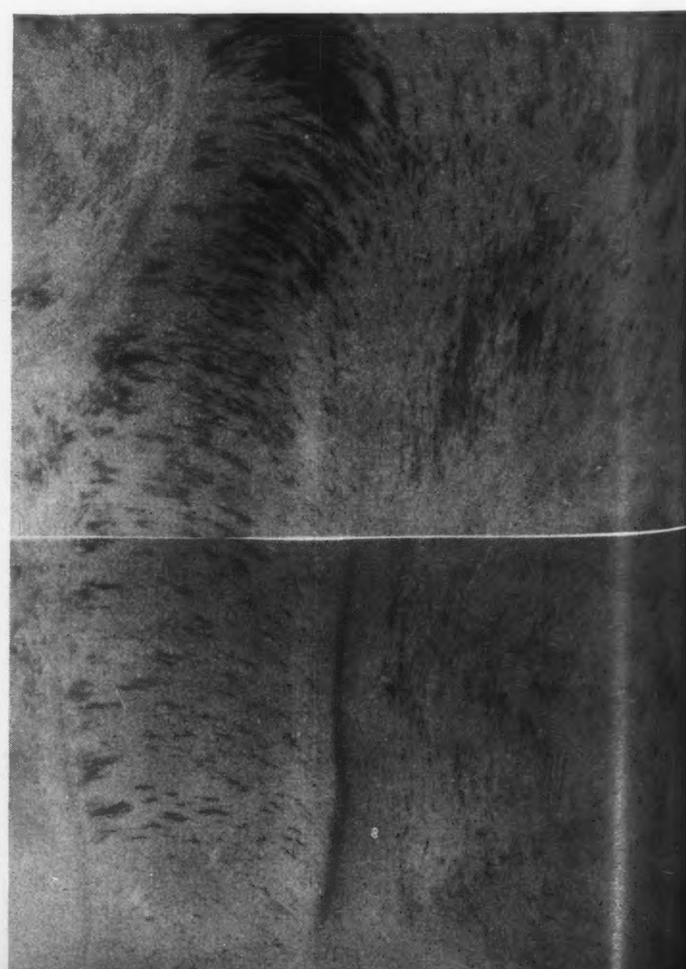


Fig. 11—Radiograph of 24x24x⅜-in. panel cast by the methods of Fig. 10. Only one-half of panel is shown.

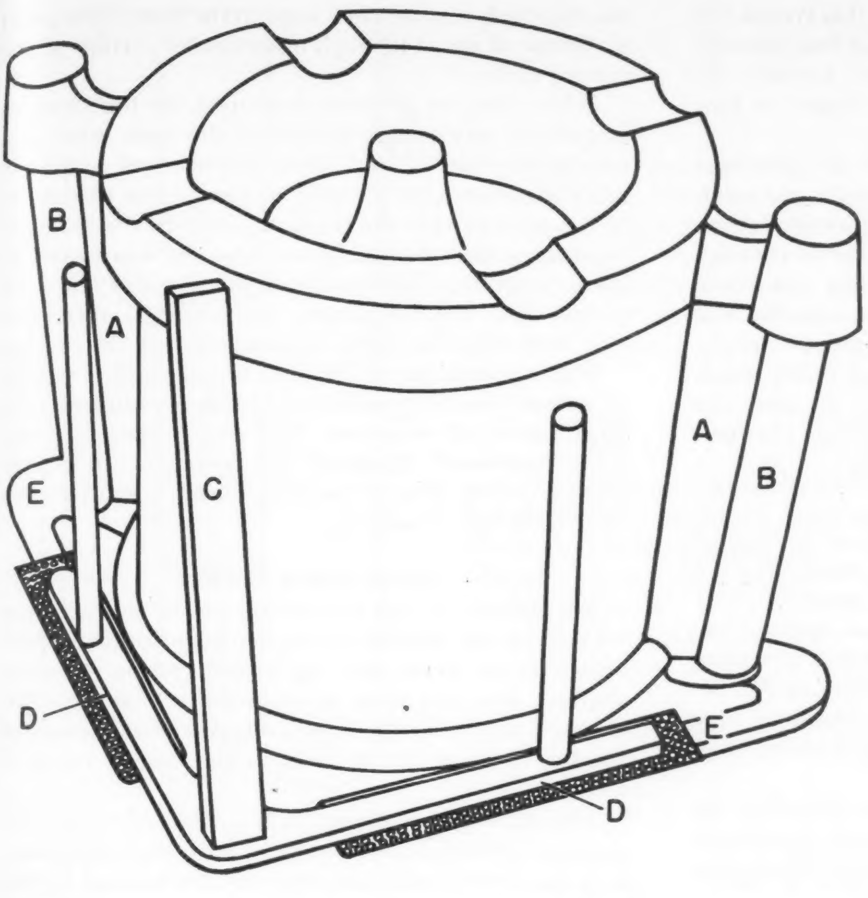


Fig. 12—Application of a conventional side gate (as described by Beck) to the casting of an aircraft wheel. Slot gate (A) runs up the side of the casting and is continuously connected with a well (B). Sprue (C) carries the metal to the lowest part of the casting, where it is screened by the skimgate (D) before continuing along runner (E) into the bottom of the well.

the entire bottom edge of the panel. Despite the uniformity of design of this panel and its gate, no pouring rate could be found by which the streaks of porosity, shown in Fig. 11 could be eliminated.

The panel illustrated was of simple design, yet the ill effects of channelling of flow are evident. An even greater opportunity for seeking preferred channels of flow occurs in production castings of non-uniform section. For these reasons, better methods of filling molds were sought.

Beck[1] describes a type of gate which represents a significant improvement over conventional bottom gating for the casting of vertical walled parts. This may be referred to as the side gate or conventional slot gate, and it has found considerable application in the casting of such magnesium-alloy parts as aircraft wheels.

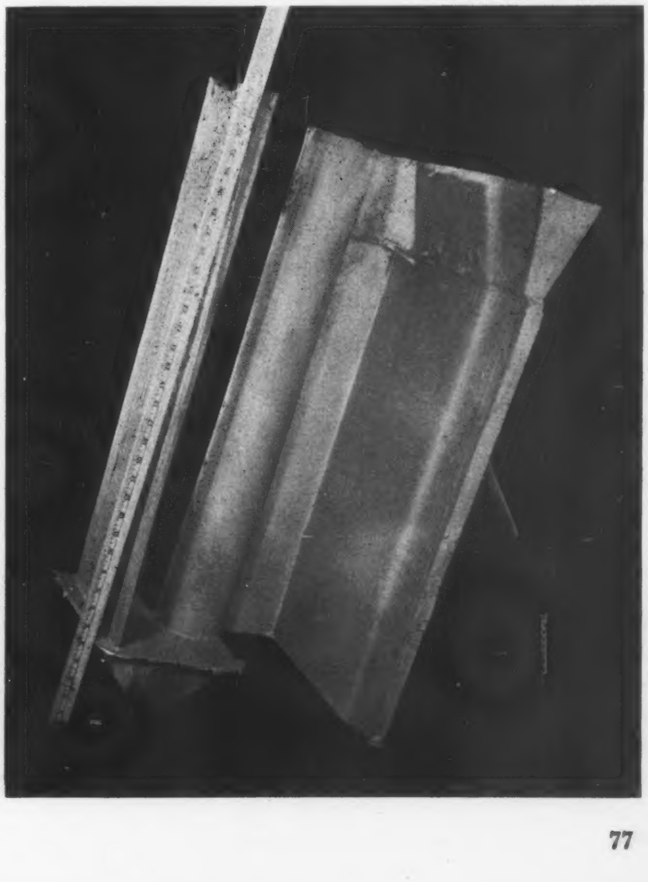
Application of Slot Gate

The method, sketched in Fig. 12, employs a slot gate *(A)* running up the side of the casting and also continuously connected with a well *(B)*. A sprue *(C)* carries the metal to the level of the lowest part of the casting cavity, as in bottom gating. Here it is screened with the skimgate *(D)*. A runner *(E)* carries the metal into the bottom of the well *(B)*.

Figure 13 shows how this system was applied to the 24x24x⅜ in. panel illustrated in Figs. 10 and 11. Figure 14 indicates the resulting freedom from the streaks of porosity typical in such a panel when bottom gated.

Fig. 13—Casting of 24x24x⅜ in. panel, of type illustrated in Figs. 10 and 11, produced by use of the side gating method shown by diagrammatic sketch (Fig. 12).

Production experience at the authors' plant has repeatedly shown that for such parts as aircraft wheels, draws and microporosity in drag parts of the casting can be eliminated much more easily by the application of this side-gating technique than by bottom gating methods.



It is believed that the effectiveness of this system lies in the fact that all metal poured need not flow through the lower portions of the casting cavity. Instead, the metal tends to flow up the well, and thence to flow horizontally into the casting cavity.

However, a study of the occurrence of shrinkage defects in castings gated in this manner led to the inference that the system was only partially effective in preventing the flow of large quantities of metal through the lower portions of the casting cavity. The occurrence of draws and porosity in many castings, and the relation of such defects to the positions of gates and risers, made it appear that during the filling of molds much of the metal still had a strong tendency to enter the casting at its lower extremities, following channels established in the initial stage of pouring.

Mold Filling Conditions

Figure 15 sketches ideal filling conditions envisioned when a slot gate is applied; Fig. 16 illustrates the type of filling which, it appears, actually occurs in many cases. It is believed that this gate, in actual application, is only a compromise between the type of flow occurring in bottom gating and the ideal type sketched in Fig. 15. Depending on the design of the casting, the ideal flow is more closely approached in some applications than in others.

The new gate described in this paper reconciles the divergent aims of securing both maximum cleanliness of the casting and ideal filling conditions for directional solidification.

It is difficult to overstate the effect that conditions of mold-filling may have on the setting-up of desirable or undesirable thermal conditions for directional solidification. Countless times in the development of a gating and risering system for a new pattern, a shrinkage defect occurs which may be attributed to the flow of too great a volume of metal through a particular portion of the casting cavity.

Before this new gate was developed, the foundryman frequently was unable to correct the basic condition causing such defect, and either had to resort to the use of chills, change the risering, or change the placement of the gates (within the limits imposed by the necessity for casting cleanliness). Many times he was forced to these costly expedients without any certainty of their success and, too frequently, such changes succeeded only in driving the defect elsewhere within the casting.

With the new gate it has been found possible readily to correct basically undesirable flow conditions in a large variety of situations. One such situation, previously mentioned, involved the casting of an experimental rolling slab. In the sand foundry, similar cases have been very numerous.

System Highly Flexible

Adaptability of this new gating system indicates that its value is not limited to the casting of deep vertical-walled parts. With any top-risered casting, however shallow, if a top riser is accessible it may be filled through a gate of this type, and thus the necessity of flowing the riser metal through the casting cavity is avoided.

This new type of gating may be adapted to the production of small bench castings. Both greater production speed and higher casting yield are realized by this method than would be attained using conventional methods. The castings are entirely satisfactory both as

Fig. 14—Radiograph of a 24x24x3/8-in. panel cast by the methods of Fig. 13. One-half of panel is shown.

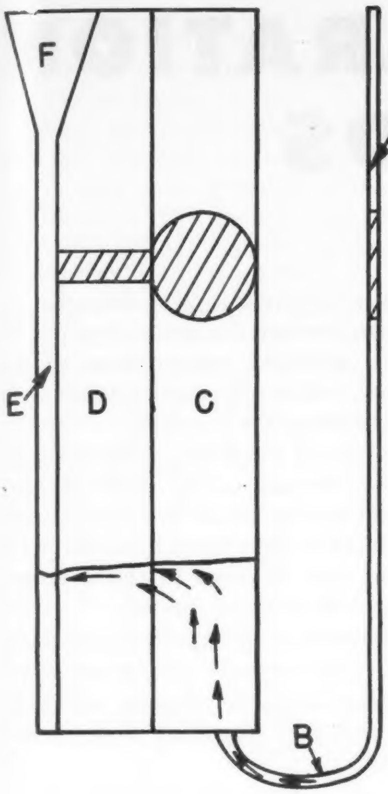


Fig. 15 (left)—Idealized flow conditions in a side gated casting. Metal rises in well, then flows horizontally into casting cavity. A—Sprue. B—Horn gate. C—Well. D—Slot gate. E—Casting cavity. F—Riser.

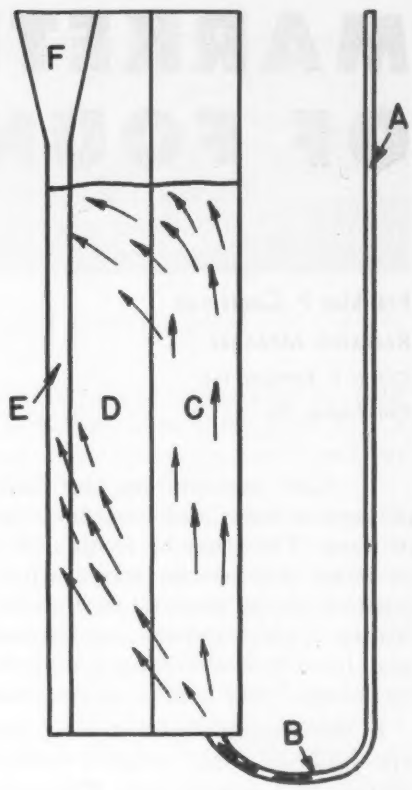


Fig. 16—Actual flow conditions in a conventional side-gated casting. Much of metal continues to flow through lower parts of casting cavity, following channels established in the early part of the pour.

to cleanliness and as to radiographic quality. Comparison of small bench castings with those shown in Figs. 6 and 7 illustrates the great range of casting types and sizes to which this gate has been adapted.

Many variations of the basic features of the new gating system are possible, and some have already been attempted. For example, the screen need not be annular; however, the cylindrical shape does afford ample screening area, and this avoids plugging the screen with any reaction-products which may form as the metal falls through the well.

One variation of the system which has found considerable successful application occurs in the practice of first bringing the metal to the level of the lowest portion of the casting cavity (as in conventional side gating), then introducing the metal into the bottom of the annular screen through an orifice. This practice facilitates molding when it is desired to extend the slot and well up through the cope to fill a top riser directly from the gate.

Disadvantages of this gating technique can be weighed against its advantages. First, the slot gate is not so easily removed from the casting as are conventional bottom gates. Secondly, there is a tendency toward centerline porosity at the junction of the slot and the casting wall. These two disadvantages are also shared by the conventional slot gate. In addition, remelting of the gate scrap involves the somewhat cumbersome operation of removing the annular screens from the melt, when the new gating system is used. In the opinion of the authors, none of these disadvantages seriously prejudices the use of this gate, in view of its many economies.

Summary

In the past, the need for avoiding turbulence in the pouring of magnesium alloy casting has dictated the use of some form of bottom gating for the great majority of shapes cast in this group of alloys. Bottom-gating methods have proved particularly effective in minimizing pouring turbulence, thereby avoiding the inclusion of non-metallic films in the casting.

However, bottom gating as a rule sets up basically undesirable conditions for the application of controlled directional solidification, and for this reason such gating methods increase the difficulty of chilling and risering castings to soundness.

A new type of gate has been developed by which clean, sound, magnesium-alloy castings of many designs can be made more economically than by previously published methods. The chief value of this gating system lies in the fact that its use corrects basically undesirable filling conditions which are difficult to avoid with other systems. By virtue of the improved mold-filling conditions attained, the problem of setting up proper conditions for controlled directional solidification is much simplified. The method has been adapted to a great variety of cast shapes.

The favorable mold-filling conditions attained by this gating method make it possible to arrive at a high degree of radiographic soundness at a lower ratio of poured weight to shipped weight, and with the use of fewer chills, than with previously utilized methods of gating magnesium alloy castings.

References

1. M. E. Brooks and A. W. Winston, "Magnesium Foundry Practice," TRANSACTIONS, American Foundrymen's Association, vol. 49, pp. 165-187 (1941).

2. A. Beck, "*The Technology of Magnesium and Its Alloys,*" tr, by F. A. Hughes & Co., Ltd. and Magnesium Elektron, Ltd., 2nd ed., p. 331. F. A. Hughes and Co., Ltd. (1941).

3. W. A. Baker, "Microporosity in Magnesium Alloy Castings," JOURNAL, Institute of Metals, vol. 71, pp. 165-204 (1945).

MARKETING PREPARATION OF FOUNDRY SANDS

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SAND DEPOSITS are the disintegration products of various rocks and have been formed in a number of ways. They may be residual or transported greater or lesser distances by water, wind or ice. The composition, shape, size and uniformity of the sand grains within a given deposit are dependent on the origin and history of the deposit and these properties can be changed only within certain limits.

In developing a sand deposit, test holes and/or pits are sunk in some ordered manner, usually at the corners of a square grid. These test holes are plotted on a map of suitable scale as are test data obtained from laboratory analyses of the borings. From this map, cross sections through the deposit can be drawn, showing the location and the arrangement of the various types of sands and the overburden.

From the map and cross sections the amount of overburden and quantity of the grades of sand can be computed and, if the deposit warrants development, a suitable mining and processing method can be formulated.

Bonded and Bank Sands

The foundry industry's sand requirements can be classified as follows: bonded sands or those containing more than 5 per cent clay; semibonded (sometimes referred to as bank sands) containing up to 5 per cent clay; and washed sands.

Bonded and semi-bonded or bank sands are characterized by sand grains naturally bonded with clay. Many varieties are mined but the predominant components are silica grains and one or more clay minerals. These grades are usually found in the younger geologic formations. Those suitable for foundry use must contain the proper qualities of grain size, refractoriness, bond, permeability and durability.

Bonded and bank sands of foundry quality are not as widespread as the geologic origin would indicate. The preparation of bonded sands for market varies according to the geology of the deposit, the amount of deleterious material present, and the type or grade of sand desired, and can best be discussed by describing typical examples such as the Albany, N. Y., and southern New Jersey districts.

The Albany sands are located in a narrow belt along the Hudson River extending from the Adirondacks southward about one hundred miles into Dutchess County and are of glacial origin. The glaciers coming from the north eroded the areas they passed over and, by constant attrition, ground most of the rock fragments to sand, eventually mixing them with shales and clay gathered along their course.

As the glaciers melted, the water deposited the sediment over a large area. Subsequently, these deposits were subjected to weathering which resulted in the decomposition of the shale fragments to form the bond and alterations of the iron minerals to the hydrated form, giving the brown color to the sands. [1]

The amount of overburden or topsoil ranges from six to 18 in. and the sand deposits vary from 12 in. to four feet. As is typical of glacial deposits, the material is not uniform and only scattered deposits are suitable for foundry use.

The deposits that are suitable for foundry use are developed by stripping the overburden from a narrow section about six feet in width and the length of the particular deposit. These strips are usually cut parallel to a property line and, after mining of the sand, the overburden from the next section is removed and spread over the mined area and the field is left in suitable condition for farming.

After stripping, the sand is carefully examined and sampled. From laboratory test data, the sand is classified as to grade or grades. The sand is then mined, as shown in Fig. 1, under the supervision of an experienced foreman, loaded on trucks and hauled to the railroad siding.

Here, as Fig. 2 shows, it is put through a rotary screen which is mounted on a truck chassis and pow-

Fig. 1—Mining and loading Albany district sand.

ered by a gasoline motor. The screen discharges to an inclined belt which throws the sand into the railroad car or truck.

Albany sands are designated by number and range from 000, the finest, to 4, the coarsest. A tabulation of the number and equivalent average fineness is shown in Table 1. With such a large variety of sands more data, such as clay content, strength and permeability are required to specify a sand.

Although one deposit may contain several grades, many deposits must be developed so that any grade can be mined when required. Since these deposits are scattered over a large area, portable mining and processing equipment is the most practical.

The sands of southern New Jersey originated from the erosion of older formations—some are marine deposits while others are terrestrial.[2] The deposits are stratified and a formation can readily be traced. This

TABLE 1—DESIGNATION OF ALBANY SANDS BASED ON APPROXIMATE A.F.A. AVERAGE FINENESS NUMBERS

Grade	Mild	Medium	Strong	Extra Strong
000	......	260	270	280
00	205	225	245	260
0	185	205	225	245
01	160	185	190	215
1	140	160	170	190
1½	120	140	150	170
2	100	115	125	150
2½	75	90	105	120
3	65	75	90	100
4	55	65	75	......

does not mean, however, that the sand deposits are uniform, as numerous test holes must be sunk to find a deposit of suitable grade.

The overburden ranges from three to six feet and the deposits of sand range from eight to 60 feet in thickness, several grades being found in the same section. At Millville, N. J., the overburden is removed by scraper wagons and bulldozers. High banks of sand are mined with a one-yard shovel handling a 1¼ yard bucket. In thinner banks, or where greater selection is required, a ⅜ yard truck shovel is used.

The material is hauled by trucks from the pit to the processing plant where it is passed through a 10 x 25 ft rotary screen and discharged to a 450 ft belt conveyor, 300 ft of which is structurally supported 35 ft from the ground. The sand is then tripped off the conveyor into the proper storage pile. A 60-ft portable conveyor, Fig. 3, is used so that piles can be stored to either side of the main conveyor. Nine basic sands are mined in as many pits and are stored under or to the side of the conveyor.

From the drilling record and close observation by the foreman, lenses and pockets of off-grade material are deleted and separately removed and used for fill or dumped with the stripping. Samples are taken to the laboratory for analysis during the daily production and if the material is not up to specification it is removed from storage.

Despite such precautions, material dug directly from the bank is apt to vary as to strength and grain size.

Fig. 3—General view of screening plant and storage.

The storage piles effectively blend these variations, and when the material is loaded from these piles it is a homogeneous mixture whose characteristics have been predetermined by laboratory analyses.

One of the nine basic sands which range in average fineness from 30 to 110 and in clay content from 2 to 25 per cent will meet the specifications for many uses. In addition, by blending one or more of these basic sands with or without clay, a sand can be prepared which will meet practically any specification.

The blending of sands is accomplished by using 3-compartment, 110-ton bins from which batches are accurately weighed and fed to a 15-cu ft sand muller. This discharges onto a 60-ft portable conveyor which feeds the sand into cars or trucks (Fig. 4).

Washed Sands

By careful prospecting and mining, followed by screening and accurate blending, high grade molding sands are produced. However, the importance of maintaining experienced field foremen and constant laboratory analysis cannot be over-emphasized.

Washed sands derive their name from the process of preparation. The deposits suitable to production are those sufficiently large to warrant the expenditure for a plant. Such deposits must contain the proper sizes and composition of grain, and must be low enough in clay content to be readily washed clean.

Assuming that the deposit is satisfactory in all respects, the main problem relative to production is the design and layout of a plant which will produce grades that are currently required and yet be flexible

Fig. 2—Screening and loading Albany district sand.

to changing markets. The general practice is to mine hydraulically and classify the sand. This may be supplemented with screening in some instances. A typical example is the operation at Manumuskin, N. J.

This deposit averages 50 ft in depth, 40 ft of which is below water level, and contains over 98 per cent silica grains, approximately one per cent clay, and a small percentage of heavy minerals. The $2\frac{1}{2}$ to 3 ft of overburden is removed by a Diesel engine powered tractor with a 5 cu yd scraper wagon.

Mining and Classifying

The mining is accomplished by a 6-in. centrifugal pump powered by a 100 hp electric motor and having an 8-in. discharge. The slurry, averaging 15 per cent solids by weight, is pumped about 1,000 ft to the plant at the rate of 1,200 to 1,500 gallons per min. or an average of 50 tons of sand per hr. It is then discharged into a storage box from which it flows into a revolving screen which scalps off the plus six mesh material which is discharged via a steel pipe from the plant.

The sand and water pass into a settling box of proper dimensions to settle plus 140 mesh grain. The overflow from this tank is passed back to a reservoir and the sand is drawn from the bottom and pumped to an overhead tank which feeds four classifiers. The classifiers, Fig. 5, use a water current of adjustable speed to produce a sand of the particular grade of fineness desired.

By regulating the feed and the classifiers, production of each grade is kept uniform. The first classifier produces a sand with an average fineness of 27, the second 35, the third 45, and the fourth 68. The discharge from the classifiers is pumped to dewatering towers and ground stored for drainage to about $3\frac{1}{2}$ per cent moisture before shipment as damp sand. This operation is illustrated by Fig. 6.

Fig. 4—View of the sand muller and loading conveyor.

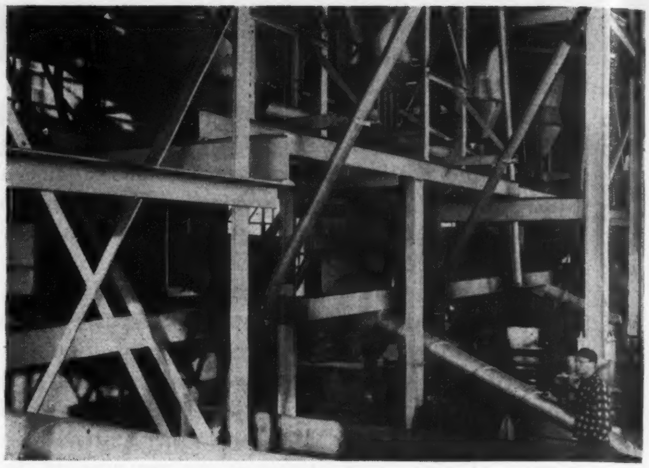

Fig. 5—View of sand washing and classifying plant.

Fig. 6—View of wash and dry plants and storage piles.

The discharge from the first classifier is sent to the dry plant where it passes through a 6 x 33 ft oil-fired dryer which revolves at 7 rpm. The dry sand is discharged onto a screw conveyor to a bucket elevator which carries it up to a combination of double deck vibrating screens. These divide the sand into the following four sandblast sizes which are stored in four 800-ton concrete silos:

6 to 10 mesh or No. 3 sandblast sand
10 to 14 mesh or No. 2 sandblast sand
14 to 24 mesh or No. 1 sandblast sand
Minus 24 mesh or No. 0 sandblast sand

Any grade of sand produced by the wash plant can be passed through the dryer and conveyed directly into cars, thus eliminating the necessity of dry storage of these grades.

The important factors in the production of uniform washed sands have been described and may be summarized as:

1. Thorough removal of overburden.
2. Control of feed to the classifiers.
3. Adjustment of classifiers.
4. Extensive use of screen analyses and other laboratory tests.

References

1. C. M. Nevin, "Albany Molding Sands of the Hudson Valley," New York State Museum Bulletin No. 263 (1925).

2. R. D. Salisbury and G. D. Knapp, "The Quaternary Formations of Southern New Jersey"; vol. XIII of the final report series of the State Geologist of New Jersey (1916).

COPPER ADDITION CONTAMINANTS

Effect on Mechanical Properties of

GRAY CAST IRON

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THE USE OF COPPER AS AN ALLOYING ADDITION to cast iron needs no explanation. Because of its availability in grades of high purity it is customary to use pure copper shot or sheared wire for ladle additions, although any other convenient form may be equally suitable. Pound-for-pound credit may be allowed for the copper addition because no copper is lost and substantially no other elements are present.

This same complete recovery of copper would be expected from the addition of copper-base alloys. In many instances, copper-alloy scrap, purchased for its copper content alone, might compete economically with high-purity copper shot. Accordingly, a series of experiments was undertaken to determine what harmful effects might result from use of copper-base alloys and the extent to which they might be safely employed as a source of copper for gray cast iron.

Elements in Copper-Base Alloys

A survey of the field of alloys indicated that only nine elements, other than copper, are found in the bulk of copper-base alloys. A tenth, bismuth, might be introduced in bearing metals, and is sometimes intentionally added to cast iron, so it was included with the group shown in Table 1 used for this investigation.

The effect of most of these elements, when added to cast iron, has been studied by other investigators, and is reported in various technical papers. It was expected that the individual effects with or without copper would be similar. However, the effect of one element in the presence of others (in addition to copper) or the interaction of two or more elements was not known. These interaction effects are sometimes pronounced as in the hardenability of steel where small amounts of several elements approximate the effect of larger amounts of fewer elements. Since scrap alloy copper is likely to contain more than two elements, attention was directed to the interactions as well as to the main effects of single elements.

Two factorially designed [1, 2] experiments were drawn up to explore the main effects and interactions as the first step in the program. The factorially designed experiment departs from the conventional practice of considering only one variable at a time and provides data which can be easily treated by statistical analysis to determine the probable reliability of the results indicated. Furthermore, the interactions and the main effects may be determined with equal precision because the same number of separate determinations are involved in each.

In this application, the ten elements were divided into two groups of five each. Two percentage levels were then chosen for each element. The higher level was set at some point where the effect would be noticeable, yet not so high as to preclude the presence of other elements at a proportionately high level. The lower percentage level was taken as one-tenth of the higher level; the purpose being to have a measurable, yet presumably ineffective amount of the element in question.

Factorial Test Percentage Levels

Table 2 shows the distribution and percentage levels for the two factorial tests. Thirty-two combinations or "compositions" are possible from each set of five elements at two percentage levels, sixteen with each element at its higher and sixteen with each element at its lower level.

Iron for the tests was prepared in a 27-in. cupola equipped with an air-volume control, a pressure gauge, and a blast-moisture control. The melting practice was kept as consistent as possible during all of the test runs. An effort was made to keep the analysis of the iron at 3.30 per cent carbon, 1.90 per cent silicon, and

TABLE 1.—TEN ELEMENTS REPRESENTATIVE OF THOSE USED IN MOST COPPER-BASE ALLOYS

Element	Normal Maximum Percentage
Aluminum	10.0
Arsenic	0.5
Antimony	0.5
Beryllium	4.0
Bismuth	2.0 (assumed)
Cadmium	1.0
Lead	30.0
Tellurium	0.5
Tin	10.0
Zinc	40.0

0.75 per cent manganese, although there was some variation in the actual analysis.

Twelve-hundred pounds of iron were tapped into an insulated holding ladle to provide the base iron for the tests. This was moved to the molding floor where 40-lb. lots, each treated separately, were taken in hand ladles and used to pour a two-bar 1.2 x 21-in. transverse-bar mold and a chill test. The alloy additions were made to the hand ladle as they were filled from the holding ladle.

Since a single holding ladle would provide only enough iron to pour 20 molds, it was necessary to use two ladles for the complete set of 32 tests. The pouring order was arranged so that only the fourth-order interaction was affected, but it was rendered useless.

The tests were made in duplicate, providing four transverse bars and two chill tests for each composition. In determining the main effects and interactions, the results of 64 determinations are involved in the transverse strength, resilience, impact strength, and deflection tests, and 32 determinations in the chill test.

A measure of the reliability of the tests was made by an analysis of variance, using the differences between molds of the same composition as a basis for determining the inherent experimental error. If the effect attributable to composition is greater than the factor representing experimental error, the reason may be either:

a. The apparent effect was achieved through sheer accident.

b. The effect is actually the result of the change in composition.

The analysis of variance provides a measure of the significance of the data in terms of the probability that the results are accidental. Thus, a significance value of 0.1 means that the chances are 1 in 10 that the indicated effect was arrived at by accident; a value of 0.001 means significance of the data in terms of the probability that the chances are only 1 in 1000.

Tables 3 and 4 show the results of the analysis of variance carried out on the data from the two factorial experiments. Tabulation of the data for the analyses summarized in these tables was accomplished by subtracting the property values of the compositions with

TABLE 2.—PERCENTAGE LEVELS OF TEN ELEMENTS ADDED WITH COPPER * IN FACTORIALLY DESIGNED EXPERIMENTS

Element	Higher Level	Lower Level
	Set I. Elements More Likely to be Found	
Antimony	0.002	0.0002
Arsenic	0.002	0.0002
Lead	0.033	0.0033
Tin	0.03	0.003
Zinc	0.033	0.0033
	Set II. Elements Less Likely to be Found	
Aluminum	0.03	0.003
Beryllium	0.008	0.0008
Bismuth	0.002	0.0002
Cadmium	0.002	0.0002
Tellurium	0.001	0.0001

* Regardless of the percentage of other elements added, the alloy addition was balanced to provide an addition of one per cent of copper.

TABLE 3.—SIGNIFICANCE OF MAIN EFFECTS AND INTERACTIONS FROM THE ADDITION OF ARSENIC, ANTIMONY, LEAD, TIN, AND ZINC WITH COPPER TO GRAY IRON

	Transverse Strength		Deflection		Resilience		Impact Strength		Chill Depth	
Elements	Effect Total (x 0.1)	Significance	Effect Total (x 1000)	Significance	Effect Total (x 10)	Significance	Effect Total (x 10)	Significance	Effect Total (x 100)	Significance
As	140		−97		107		145		−127	
Pb	−2386	0.01	−2539	0.01	−5433	0.01	−2335	0.01	287	0.2
Sb	−252		−119		−423		−765	0.1	39	
Sn	−140		9		25		−555		1	
Zn	−324		−173		−421		155		135	
As-Pb	84		95		195		−265		19	
As-Sb	50		131		285		185		−69	
As-Sn	−86		131		−103		115		−83	
As-Zn	258		393		859	0.2	−555		−53	
Pb-Sb	−140		−195		−295		−335		−31	
Pb-Sn	−196		−203		−291		95		47	
Pb-Zn	120		−73		−45		305		69	
Sb-Sn	58		81		115		245		111	
Sb-Zn	26		15		61		−5		−95	
Sn-Zn	10		23		137		−615		3	
As-Pb-Sb	110		19		73		−145		−135	
As-Pb-Sn	270		259		569		245		−89	
As-Pb-Zn	−246		−431		−825	0.2	−245		−51	
As-Sb-Sn	−188		−57		−289		−325		31	
As-Sb-Zn	−40		−7		−39		5		−95	
As-Sn-Zn	−148		−23		−231		−165		−21	
Pb-Sb-Sn	22		421		579		375		113	
Pb-Sb-Zn	26		27		−95		−135		−181	
Pb-Sn-Zn	−38		11		9		−285		49	
Sb-Sn-Zn	172		107		343		385		−123	
As-Pb-Sb-Sn	44		111		163		−35		−11	
As-Pb-Sb-Zn	152		377		697		−5		−73	
As-Sb-Sn-Zn	122		1		35		635		113	
As-Pb-Sn-Zn	264		345		501		125		−147	
Pb-Sb-Sn-Zn	−96		47		−13		−285		143	
Experimental error — based on standard deviation between duplicate molds (corrected for ladle differences)	±170 lb./bar		±0.04 in.		±5 ft.lb./bar		±3+ ft.lb./bar		±0.2 in.	

the element or elements at the lower percentage level from those of the corresponding compositions in which the same element or elements are at the higher percentage level. In the factorial design employed in these analyses, there were sixteen differences so obtained for each main effect and each interaction, when the elements were run in duplicate, there were two sets of sixteen values for the chill tests and 32 values for the other tests. The 'effect totals' cited in the tables were obtained by subtracting the sum of all 32 values for the chill test and all 64 values for the other tests for each main effect and each interaction, when the element or elements were at the lower percentage level, Table 2, from the sum of the same number of values when the element or elements were at the higher percentage level, Table 2. The analysis of variance permitted the consideration of masses of data without the need of recording the individual values.

The fact that only a few of the total number of main effects and interactions are significant does not necessarily mean that the elements have no effect. It means only that the experimental error was not small enough to permit the effects to assert themselves.

Only lead and bismuth showed consistently significant results. A few other main effects and interactions showed significance in some properties, but except for Te and Al-Te the significance values are not strong. Furthermore, most of the interactions showing significant values contain one of the elements shown to be harmful, lead or bismuth.

In view of this, it does not appear that the interactions are important in themselves, but that the presence of one potent element may mask the effect of others.

Actually, the interactions may be more beneficial than harmful. If it can be assumed that the effect totals are qualitatively correct, Table 5 indicates that increasing the number of elements added with the copper tends to decrease the harmful effects.

In addition to the two factorially designed experiments which have just been described, a large number of tests were made with only one element at a time added with copper in order to determine the amount that might be tolerated. The percentages of the elements added individually to the iron with 1 per cent of copper are listed in Table 6, and the results of the tests are summarized in the graphs, Fig. 1 to 10, inclusive, and the discussions for the individual elements.

TABLE 5.—PERCENTAGES OF BENEFICIAL RESULTS SHOWN IN EFFECT TOTALS FOR FACTORIAL EXPERIMENTS

Number of Elements Added With Copper	Number of Beneficial Effects	Number of Harmful Effects	Per Cent Beneficial Effects
		Set No. I	
One	7	18	27
Two	30	20	60
Three	27	23	54
Four	18	7	72
		Set No. II	
One	3	22	12
Two	26	22	52
Three	12	38	24
Four	11	14	44

TABLE 4.—SIGNIFICANCE OF MAIN EFFECTS AND INTERACTIONS FROM THE ADDITION OF ALUMINUM, BERYLLIUM, BISMUTH, CADMIUM, AND TELLURIUM WITH COPPER TO GRAY IRON

	Transverse Strength		Deflection		Resilience		Impact Strength		Chill Depth	
Elements	Effect Total (x 0.1)	Significance	Effect Total (x 1000)	Significance	Effect Total (x 10)	Significance	Effect Total (x 10)	Significance	Effect Total (x 100)	Significance
Al	22		−149		−138		−140		12	
Be	−26		−363		−468		−640		−16	
Bi	−562	0.01	−1017	0.01	−2182	0.01	−820	0.1	278	0.1
Cd	−124		−445		−702		−20		32	0.01
Te	−306		−367		−1164	0.1	770	0.1	514	
Al-Be	−144		−139		78		−280		−42	
Al-Bi	216		247		692		320		−48	
Al-Cd	−2		−37		260		0		10	
Al-Te	212		93		442		1570	0.01	0	
Be-Bi	−292		−311		−822		−460		12	
Be-Cd	−274		−359		−730		−120		−58	
Be-Te	−64		−17		−224		290		−44	
Bi-Cd	18		55		136		−160		−108	
Bi-Te	180		357		618		−130		170	
Cd-Te	82		165		34		230		56	
Al-Be-Bi	−342	0.1	−451		−788		−260		70	
Al-Be-Cd	−92		−243		−208		−80		−96	
Al-Be-Te	−206		−209		−498		−370		10	
Al-Bi-Cd	136		163		586		−500		−6	
Al-Bi-Te	−42		−331		−304		−250		12	
Al-Cd-Te	−236		−379		−824		−450		−46	
Be-Bi-Cd	−452	0.05	−519	0.1	−1292	0.1	−420	0.1	102	
Be-Bi-Te	−146		−145		−450		470		80	
Be-Cd-Te	−336	0.1	−341		−902		−470		−90	
Bi-Cd-Te	264		605	0.1	904		290		28	
Al-Be-Bi-Cd	150		−255		134		−300		180	
Al-Be-Bi-Te	−220		−29		−284		50		50	
Al-Be-Cd-Te	158		503		1000		230		−48	
Al-Bi-Cd-Te	−42		−159		−346		−750		10	
Be-Bi-Cd-Te	−2		143		128		−210		−26	
Experimental error — based on standard deviation between duplicate molds	±170 lb./bar		±0.03 in.		±6 ft.lb./bar		±4 ft.lb./bar		±0.13 in.	

Table 6.—Quantities of Contaminants Added Individually to Gray Iron

Element	Test Run No.	Per Cent Added to Iron With 1 Per Cent Copper
Al	56	0.1
	59	0.001, 0.01, 0.05, 02
As	55	0.005
	57	0.001
	58	0.01
	59	0.0005, 0.01
Be	56	0.04
	59	0.004, 0.02
Bi	56	0.02
	59	0.0001, 0.001, 0.01, 0.1
Cd	56	0.01
	59	0.0001, 0.0006, 0.001, 0.006
Pb	55	0.1
	57	0.005, 0.010, 0.020. 0.030
	58	0.04—held for time effect
	59	0.0001, 0.001, 0.01, 0.025, 0.05, 0.075, 0.1, 0.2
Sb	55	0.005
	57	0.001
	58	0.01
	59	0.0005, 0.01
Sn	55	0.1
	58	0.02
	59	0.001, 0.01, 0.1, 0.2
Te	56	0.005
	59	0.0005, 0.001, 0.0025
Zn	55	0.1
	57	0.005, 0.010, 0.020, 0.030
	58	0.04—held for time effect
	59	0.001, 0.01, 0.025, 0.05, 0.075, 0.2

Also, a few commercial copper alloys were used in order to compare their effects with those of the synthetic alloys.

Since the test data were obtained from several different base irons, no two of which had identical chemical or physical properties, it appeared advisable to express the effects of the various additions in terms of the percentage of change in properties from those of the base iron with 1 per cent copper alone. These percentile values were then plotted in Figs. 1 to 10, inclusive, and examined for trends.

The results of the two factorially designed experiments conducted in duplicate, appear in the figures as crosses joined by broken lines, while those of experiments in which the elements were added individually appear as solid circles with trends shown by solid lines. Other variations imposed in the tests, such as using inoculants, are indicated on the figures.

Experimental Error

Some caution should be exercised in interpreting the curves. Where the factorial tests indicate that the experimental error is greater than the effect of the addition, the slope of the curve is, at best, only an estimate. Furthermore, the experimental error is often greater than the maximum effect indicated by the curves for the entire percentage range covered by the elements added individually.

In testing the irons, the arbitration bars were first sand blasted lightly. They were then broken by transverse loading on 18-in. centers in accordance with ASTM specifications. Bars were placed on the machine with the cope side up, and deflections were determined with an autographic deflection gauge. Impact tests were made on the ungated half of the bars from the transverse test using a six-in. span and an energy input of 74 ft.-lb.

The inner halves of the broken impact specimens were machined to provide tensile specimens, with button ends to fit the grips of the tensile testing machine and with a reduced section of 0.750 in. in diameter. Sections from these pieces 0.75 in. long were also used for the hardness tests. Depth of chill was determined by measuring the white zone on the broken chill test. Resilience was calculated from the area underneath the transverse load-deflection curve.

Effect of Aluminum and Copper. The data represented in Fig. 1 indicate that the effect of raising the aluminum content from 0.003 to 0.03 per cent in the iron was within the limits of the experimental error and, therefore, is not significant. In fact, no appreciable effect occurred until the aluminum addition approached 0.1 per cent. A greater effect resulted from the 0.2 per cent addition, but such a large addition would not be obtained by using a commercial copper-base alloy in the charges.

Aluminum Addition Functions

It may be inferred that all additions of aluminum within the range of percentages shown are beneficial because the tensile, transverse, and impact strengths, deflection, and resilience are above the corresponding values for the base iron with copper only. The Brinell hardness is relatively unaltered, but the chill depth is cut about one-half.

Many investigators have reported beneficial results from the use of small additions of aluminum. Aluminum is generally considered to be from one-third to one-half as effective as silicon as a graphitizer. It may also function as a deoxidizer.

Massari [3] recommends that aluminum should not be added in excess of 0.1 per cent because of the danger of formation of pinholes. Smith and Aufderhaar [4] likewise suggest that aluminum be kept 0.1 per cent when used as a softener or deoxidizer, and below 0.5 per cent when used as graphitizer. Ploye [5] reported that 0.01 to 0.02 per cent additions of aluminum increased the fluidity of gray iron, probably by reducing the oxygen content.

Antimony is a normal component of most pig irons and can generally be found in cast iron as a tramp element. It is not often added deliberately.

Spencer and Walding [6] found that antimony lowered both the transverse and impact strengths and increased the hardness of cast iron.

The curves shown in Fig. 2 conform to the findings of Spencer and Walding, although the percentages of antimony used are much smaller. Significance of the downward trend for impact strength was indicated in the analysis of variance.

Antimony cannot be considered beneficial, in the light of these data, but the percentages likely to be introduced from copper alloy are small.

Like antimony, arsenic is found in small amounts in pig iron. Spencer and Walding, Smith and Aufderhaar, Hurst,[7] and others believe that arsenic causes no bad effects up to 0.1 per cent in gray iron. This is well

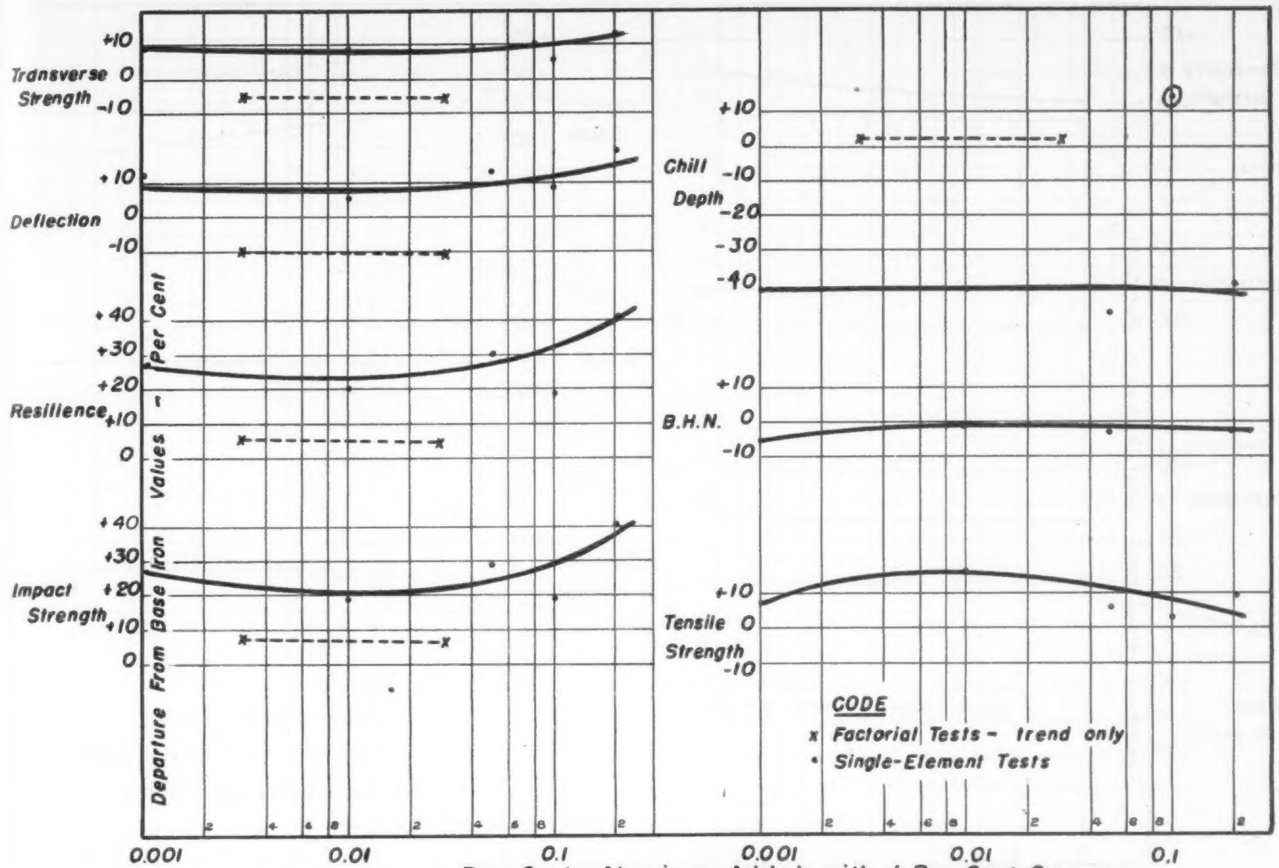


FIG. 1 – EFFECT OF ALUMINUM AND COPPER.

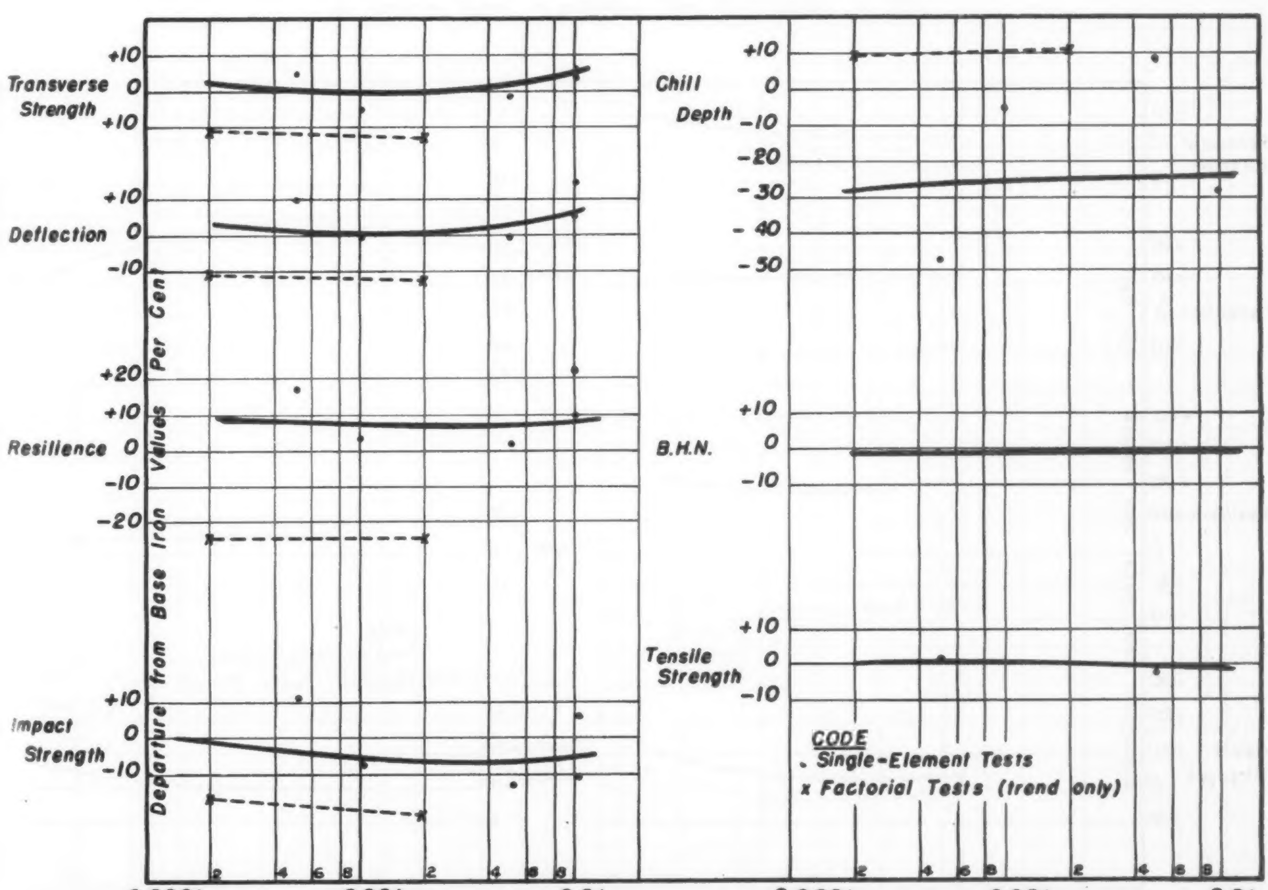


FIG. 2 – EFFECT OF ANTIMONY AND COPPER.

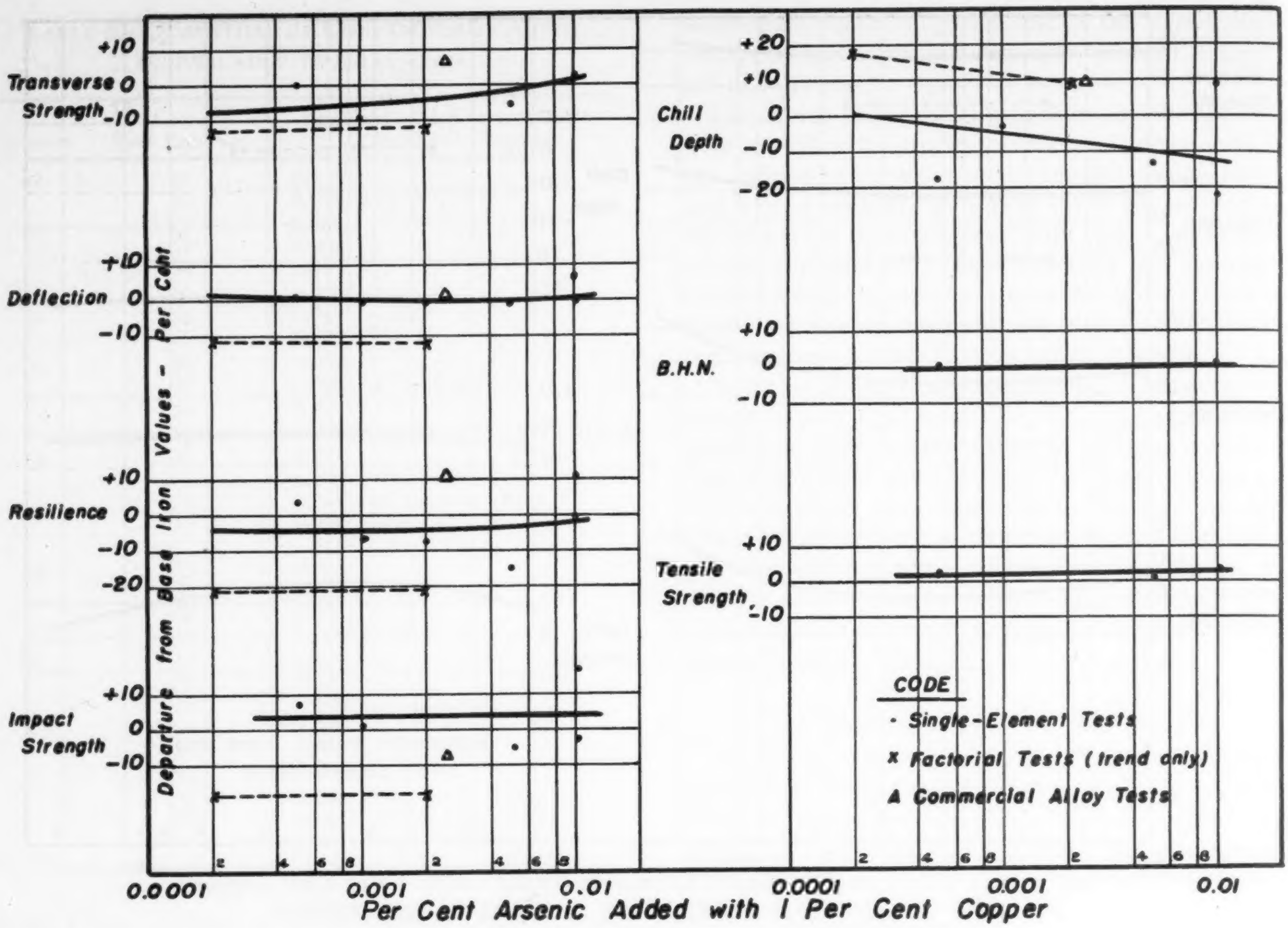


FIG. 3 - EFFECT OF ARSENIC AND COPPER.

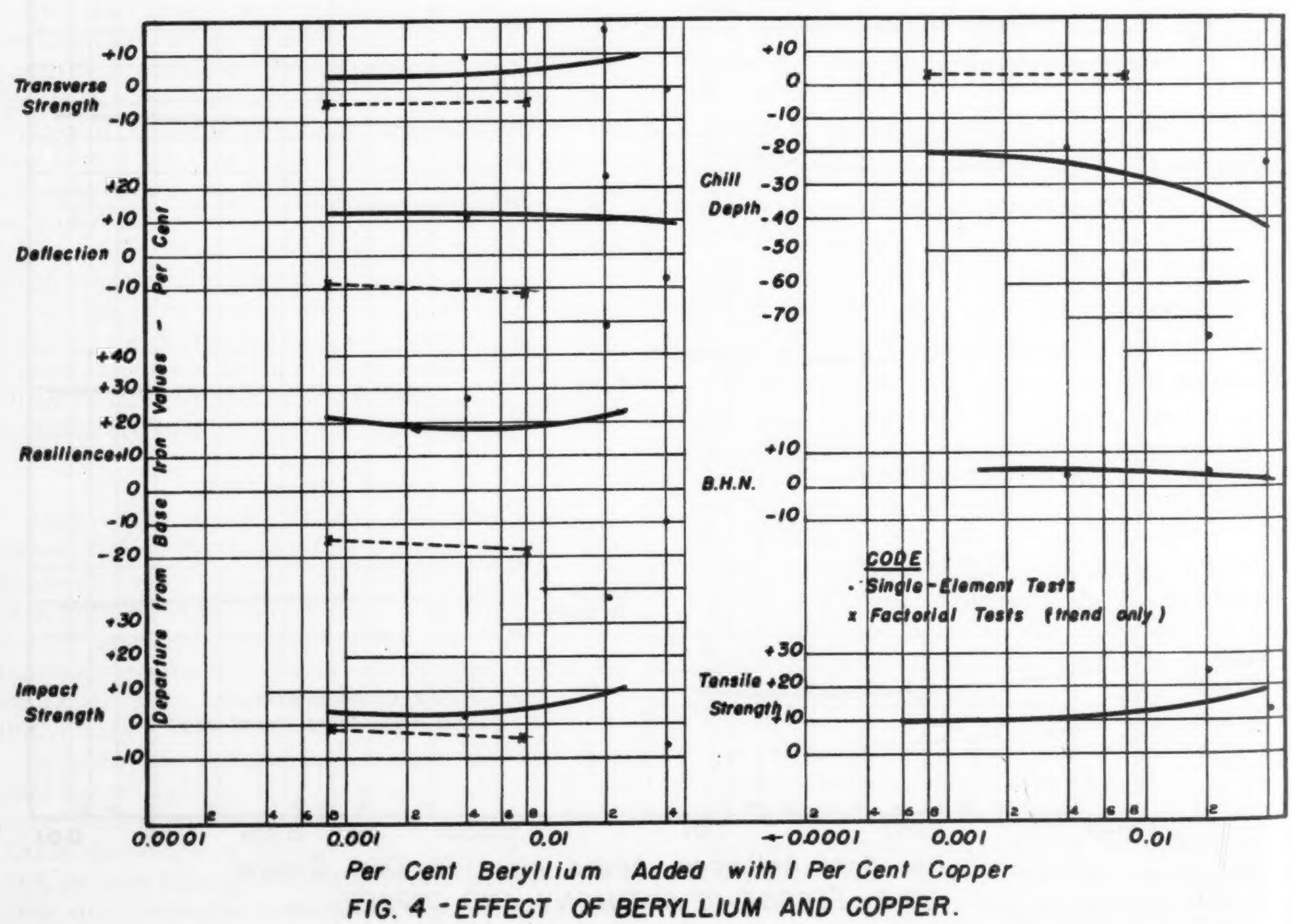


FIG. 4 - EFFECT OF BERYLLIUM AND COPPER.

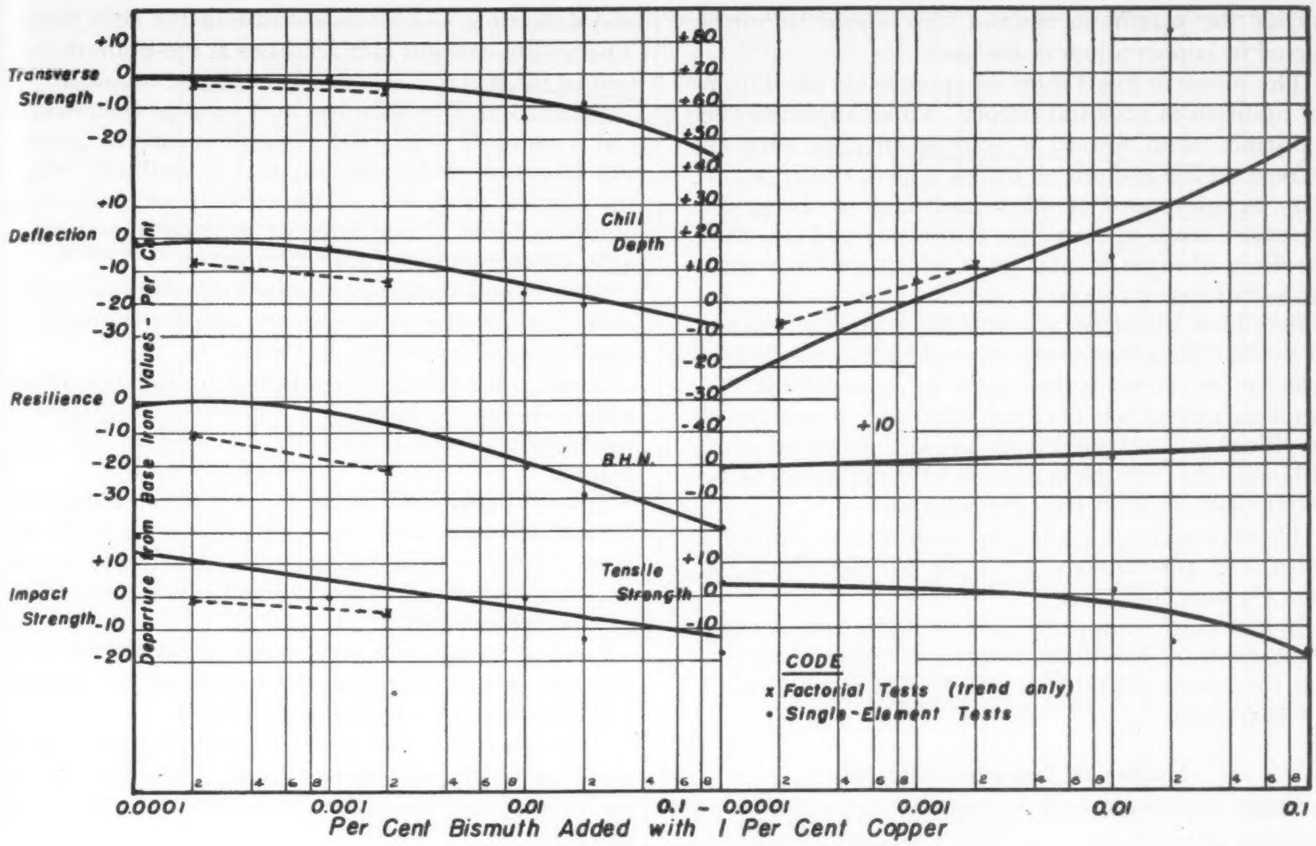


FIG. 5 - EFFECT OF BISMUTH AND COPPER.

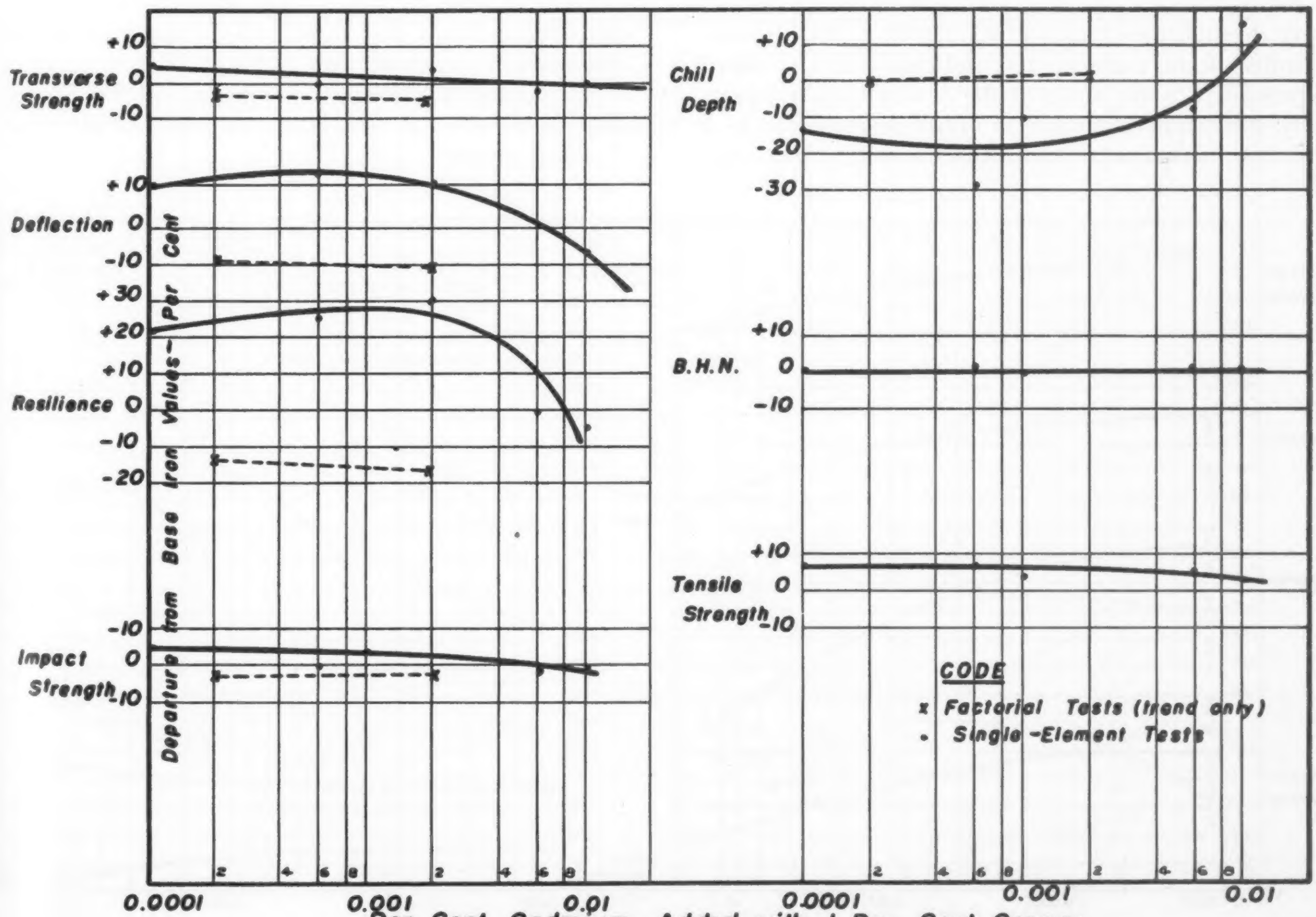


FIG. 6 - EFFECT OF CADMIUM AND COPPER.

outside the maximum amount that would be introducted by copper alloys in the melt.

The curves in Fig. 3 show no appreciable effect from the addition of arsenical copper. There appears to be a distinct trend toward a decrease in chill with an increase in the amount of arsenic added, which is contrary to the reports of other investigators. However, the entire range of the points shown in Fig. 3 is within the limits of experimental error, which are fairly wide for a chill test of this type.

Beryllium is effective as a deoxidizer, and it seems unlikely that the amounts represented in Fig. 4 would be sufficient to do more than serve as a deoxidizer. No significant effect was detected when the percentage of beryllium was increased from 0.0008 to 0.008 per cent, although the beryllium-treated iron appeared to be better than the iron with copper alone.

There is some indication that additions of beryllium above 0.01 per cent are decidedly beneficial, but the data are not conclusive.

In summary, it appears that no harm would come from the use of beryllium copper as a source of copper, but the results probably would not justify the cost of the beryllium.

Mechanical Properties Affected

Smith and Aufderhaar [4] reported that additions of bismuth increased the "life" of molten gray iron. However, the mechanical properties suffered greatly, although virtually no residual bismuth could be found in the iron.

Figure 5 shows effects of adding bismuth (with copper) in quantities ranging from 0.0001 to 0.1 per cent. Results of the factorial test indicate that the effects represented by the slope of the dotted lines are probably quantitatively correct. This corresponds to a decrease in transverse and impact strength, resilience, and deflection, and to an increase in the chill depth. The tensile strength also decreases as the bismuth content of the metal is raised.

Bismuth may be harmless and perhaps even beneficial if no more than 0.001 per cent is added. Quantities in excess of this amount will undoubtedly affect the physical properties of the iron adversely. In small amounts, bismuth may improve the iron by serving as a deoxidant, as suggested by Chubb.[8]

Spencer and Walding [6] reported that cadmium additions lowered the transverse and impact strengths of cast iron, and raised the hardness.

These conclusions are confirmed by the data represented in Fig. 6. None of the factorial tests showed mathematical significance, but the trends are consistent.

It would appear from Fig. 6 that cadmium does not become harmful until the addition exceeds 0.005 per cent. This is one-half the amount that would be obtained by adding the conventional one per cent cadmium-copper alloy.

Lead appears to be a very potent element so far as its effect on gray iron is concerned, in spite of the fact that none was found in the lead-treated iron.

The data from which Fig. 7 was drawn point conclusively to the harmful effects of lead. The trends shown by the slopes of the dotted lines were statistically significant.

The curves indicate that additions of lead not exceeding 0.005 per cent (0.01 lb. per ton) are probably harmless. When lead is intentionally added to copper-base alloys, even to improve the machinability, it exceeds this amount, and most leaded copper alloys are considerably richer in lead.

Throughout all the tests in which lead was a component, the effect of lead masks the effect of the other elements present.

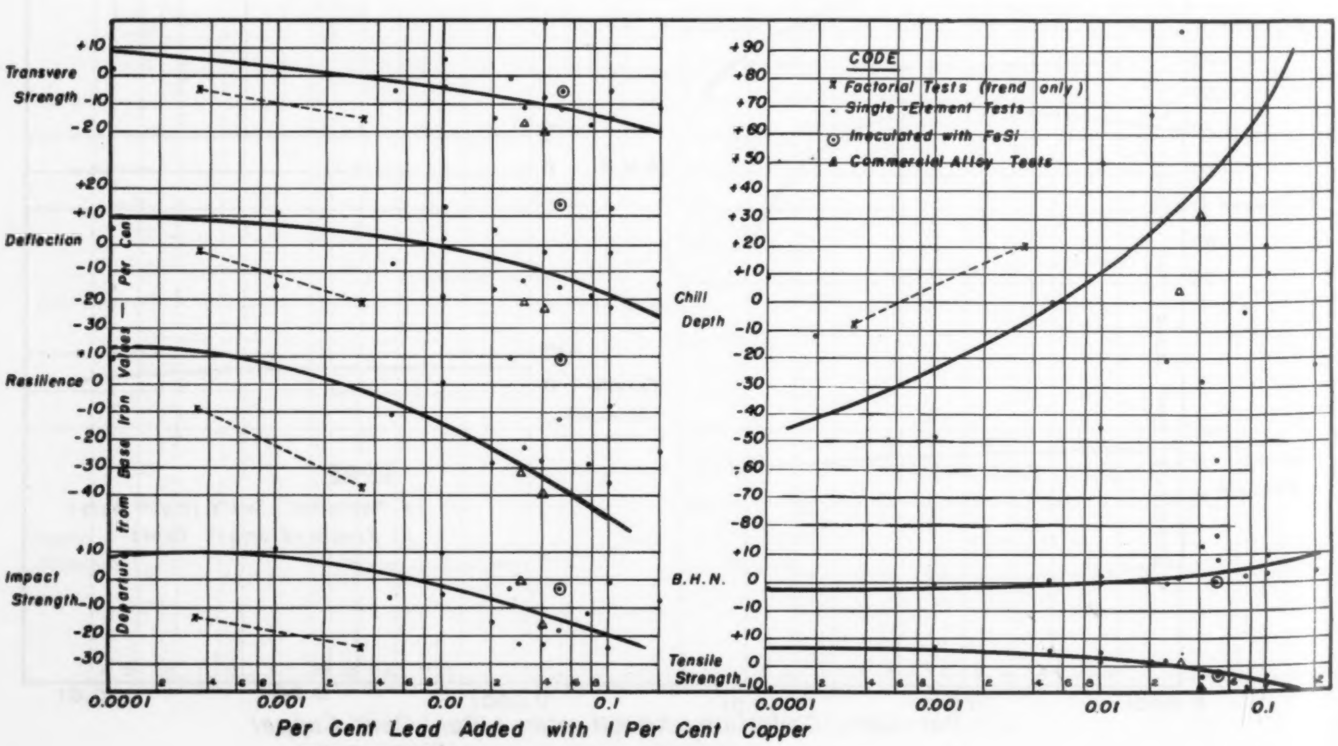
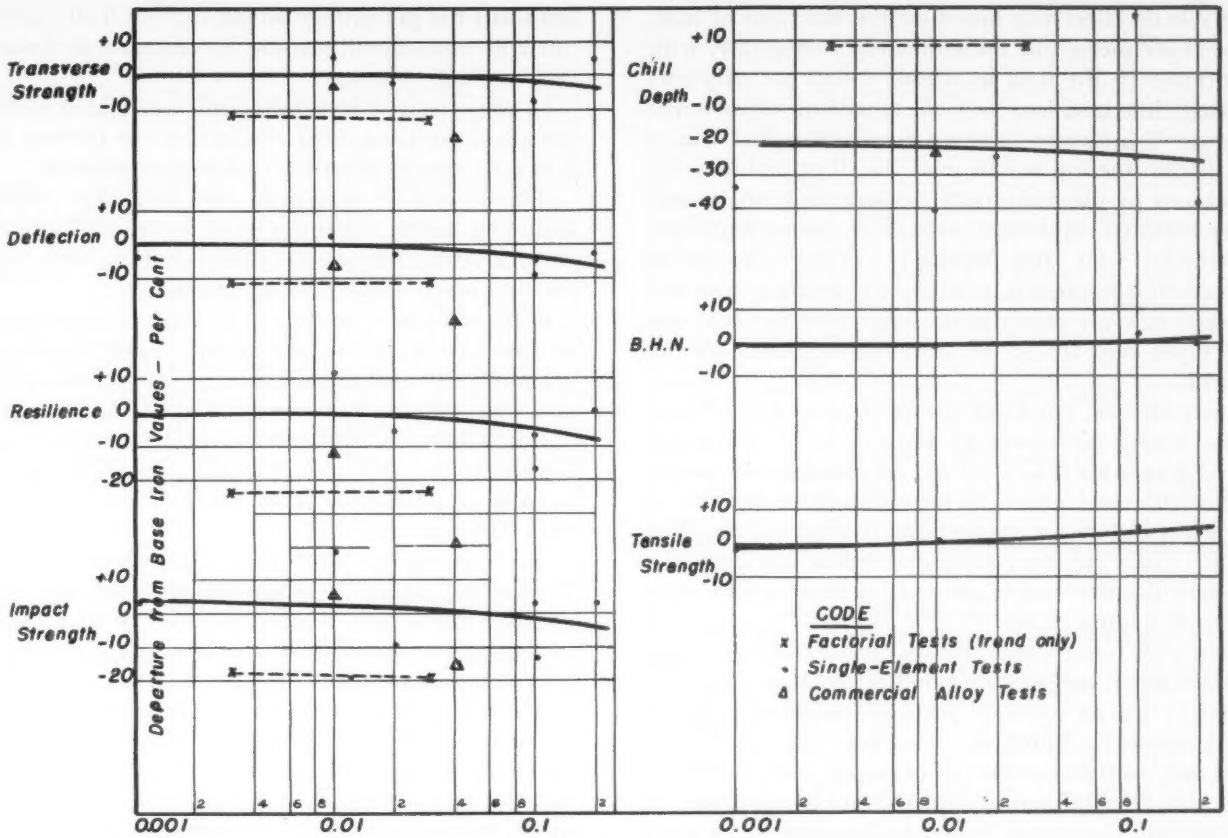
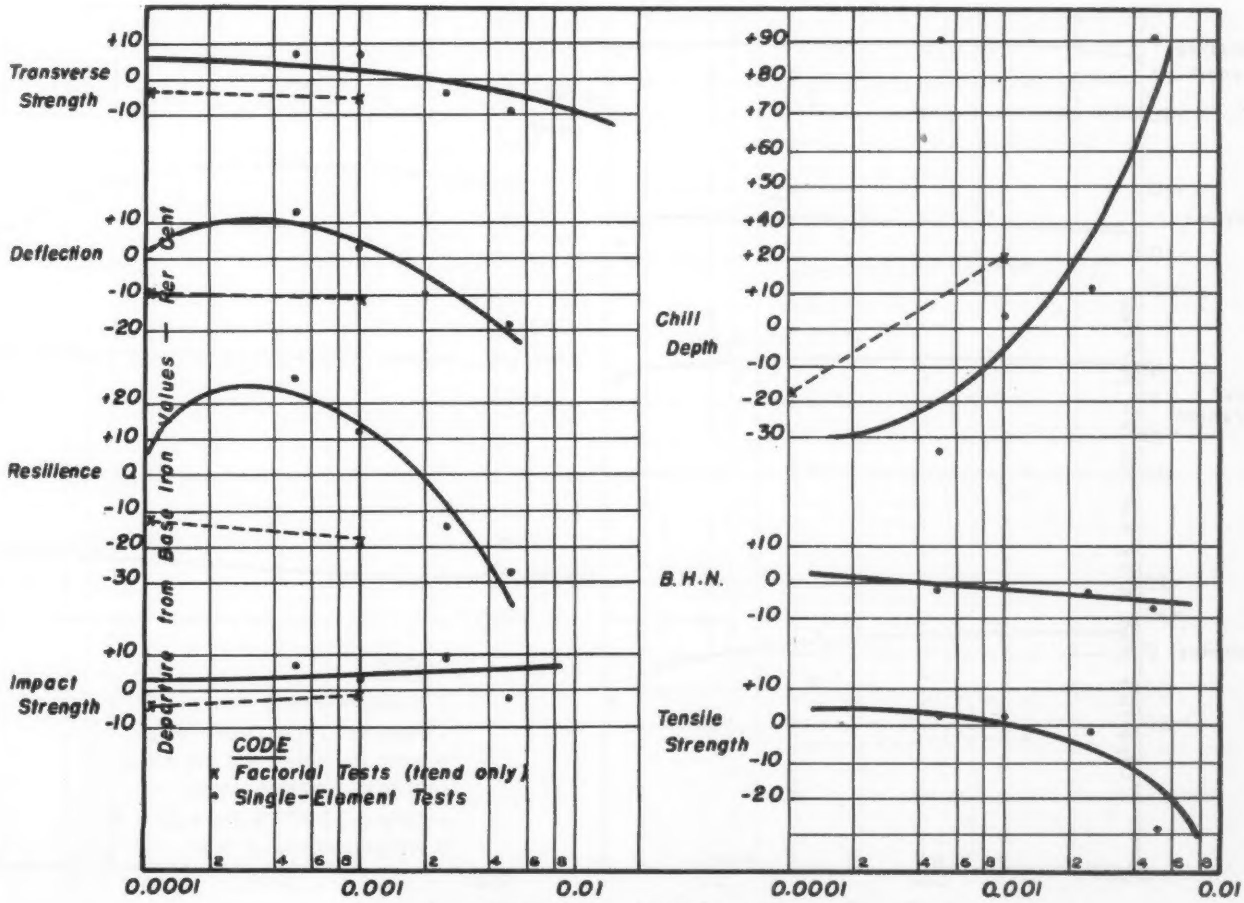


FIG. 7 - EFFECT OF LEAD AND COPPER.



Per Cent Tin Added with 1 Per Cent Copper

FIG. 8 - EFFECT OF TIN AND COPPER.



Per Cent Tellurium Added with 1 Per Cent Copper

FIG. 9 - EFFECT OF TELLURIUM AND COPPER.

Very little effect was noted on the hardness of lead-treated specimens, but the chill increased greatly with an increase in the lead addition. Other investigators reported that lead increases the retention of carbides.

Figure 8 indicates that tin has little effect but is slightly detrimental to cast iron. In all probability, tin introduced by the addition of copper-tin alloys would not be harmful. Most authorities cite tin as a hardener.

Williams, Sims, and Newhall [9] claimed that tin is retained in iron melted in an electric furnace, but that lead and zinc are eliminated. They believed that less than 1 per cent tin in the iron had no effect on the graphite.

Much interest has been shown during recent years in the strong chill-forming tendencies of tellurium-treated gray irons. The CAST METALS HANDBOOK [3] states that as little as 4 grams of pure tellurium per ton of iron will produce an appreciable increase in the chill depth. The extreme potency of tellurium, together with its volatility, makes control a difficult problem in tellurium-treated irons.

Even with tellurium additions below 0.005 per cent, marked effects are indicated in Fig. 9. The effects for resilience, impact strength, and chill depth were found to be statistically significant. However, the significance refers only to the net effect of changing from 0.0001 to 0.001 per cent tellurium and the actual presence of the hump in the curves is not verified, though strongly indicated by the data.

Based on these data, tellurium appears to be harmless until the percentage added exceeds 0.001 per cent, but this undoubtedly would be changed if the actual recovery were known.

In these tests, where tellurium was added as a copper alloy, there was little evidence of the fuming which generally results from use of the pure element.

There is little reason to conclude that tellurium alone is a useful addition except for its chill increasing powers. However, small amounts, added with copper, do not appear to be difficult to control.

Zinc volatilizes so far below the temperature of molten cast iron one would not expect much to be retained. Spencer and Walding [6] found 0.04 per cent zinc remaining in iron to which brass had been added, and 0.15 per cent zinc after a similar treatment using Tobin bronze. The curves in Fig. 10 indicate that zinc has a negligible effect when the amount added is less than 0.05 per cent.

Table 7 suggests limits for the ten elements studied. These percentages represent the approximate point at which harmful effects predominate, or at which the curves in Fig. 1 through 10 cut downward through the line of zero departure.

Aluminum, antimony, arsenic, beryllium, cadmium, tin, and zinc did not appear to exert any important effect on the microstructure. The graphite flakes in the lead-treated iron were somewhat more ragged than usual, but the matrix was normal and there was no unduly large amount of eutectiform (AFA-ASTM Type D) graphite.

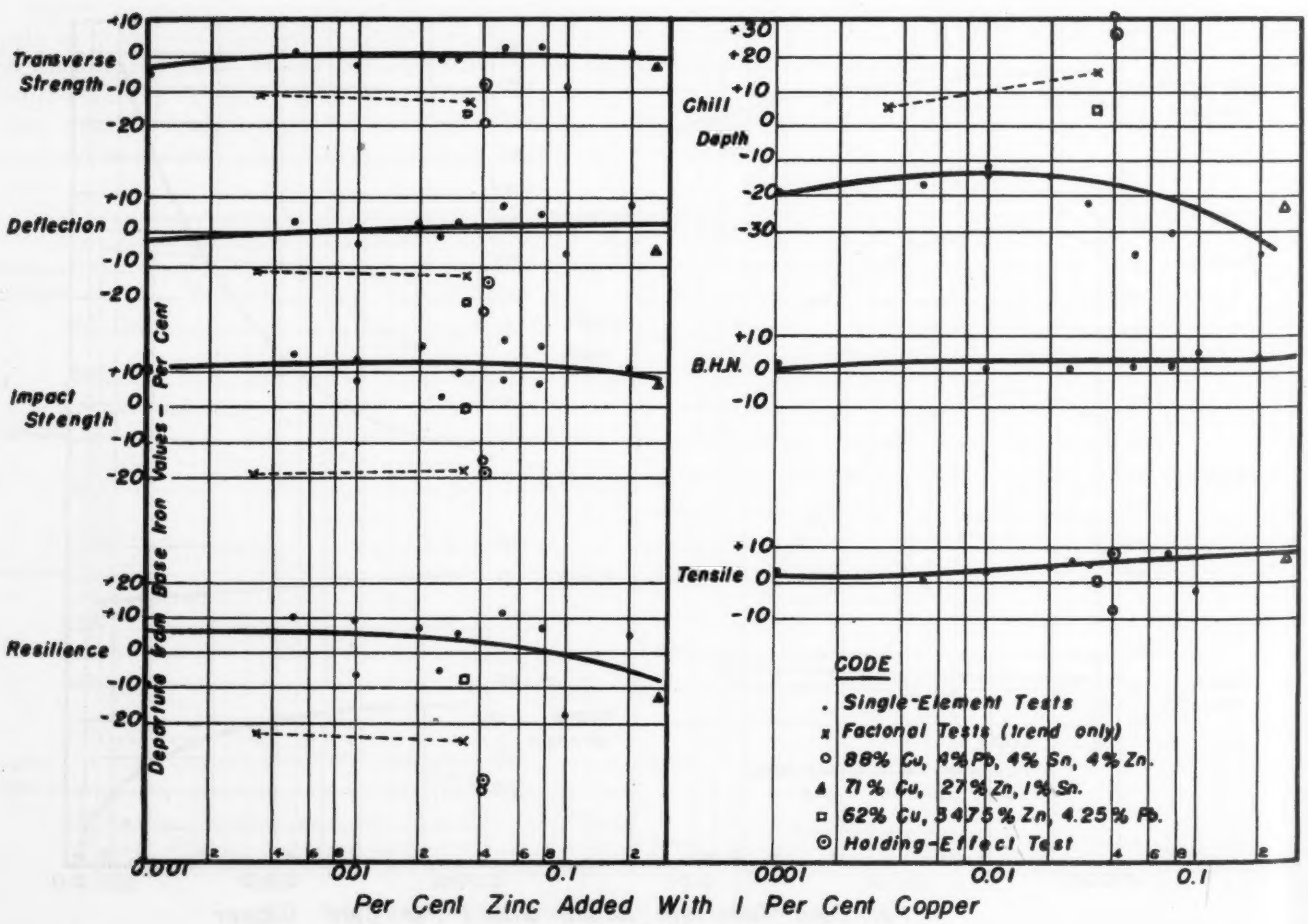


FIG. 10 – EFFECT OF ZINC AND COPPER.

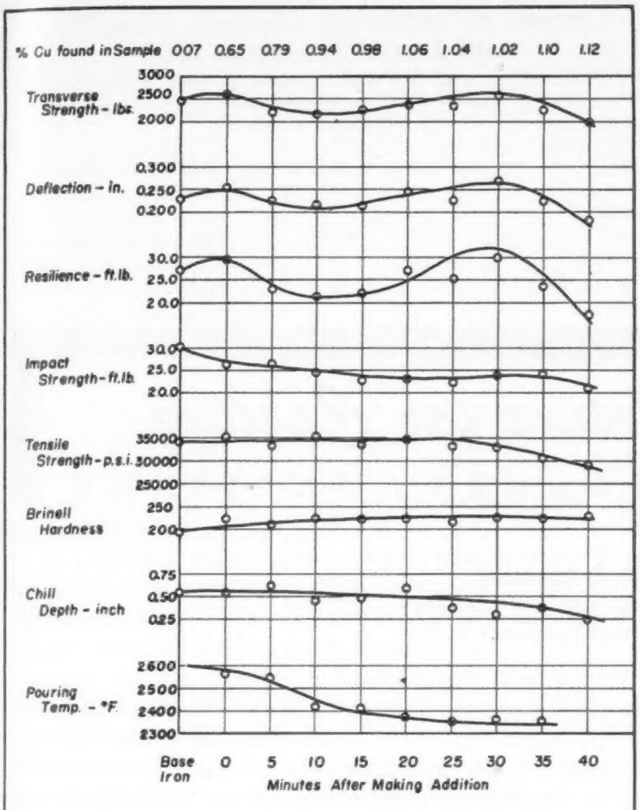


FIG. 11- EFFECT OF HOLDING TIME ON IRON TREATED WITH 0.04 % LEAD AND 1. % COPPER

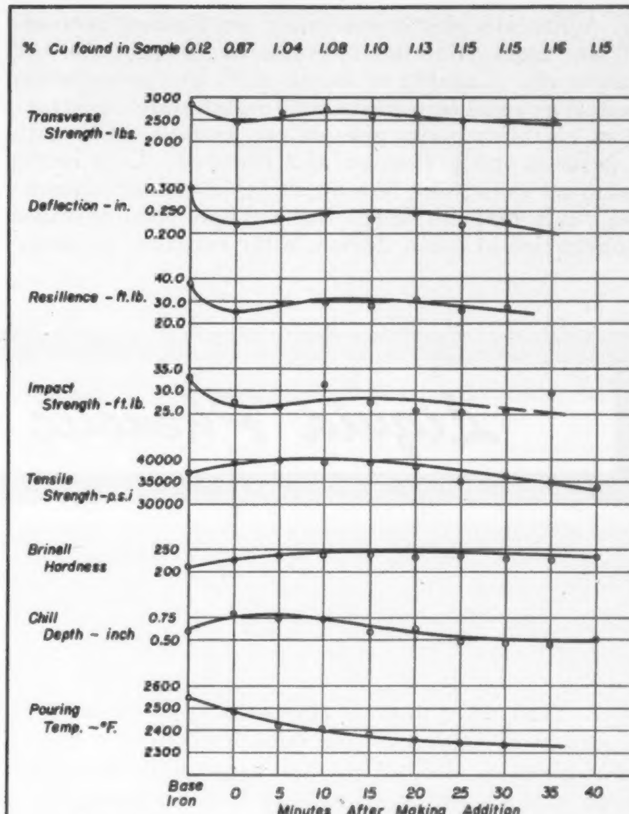


FIG. 12- EFFECT OF HOLDING TIME ON IRON TREATED WITH 0.04 % ZINC AND 1 % COPPER.

Bismuth appeared to promote the eutectiform type of graphite. In a specimen from the bar treated with 0.1 per cent bismuth, the graphite was almost exclusively of the Type D classification, in a predominately ferritic matrix.

In order to investigate the possibility of eliminating contaminating elements by allowing them to volatilize, 1200 lb. of iron was tapped into each of two insulated ladles. One mold was poured from the base iron in each ladle. One ladle was treated with 0.04 per cent lead and 1 per cent copper. A mold was poured as soon as possible after the addition was made, followed by others at five-minute intervals for 40 min.

The second ladle was treated similarly with an addition of 0.04 zinc instead of lead.

Figure 11 shows the results of the test in which lead was added. The first effect was an increase in the mechanical properties of the iron, followed by a drop, possibly as a result of more intimate mixing of the lead. The second drop after 30 min. is probably a result of the decreasing temperature.

TABLE 7.—SUGGESTED MAXIMUM PERMISSIBLE PERCENTAGES OF FOREIGN ELEMENTS THAT CAN BE ADDED WITH COPPER TO CAST IRON

Element	Maximum Per Cent Permissible
Aluminum	0.1+
Antimony	0.01+
Arsenic	0.01+
Beryllium	Indefinite, but probably above 0.2
Bismuth	0.001
Cadmium	0.005
Lead	0.005 or less
Tellurium	0.001
Tin	0.01
Zinc	0.01

The suggested limiting percentages for each of the foreign elements are given as follows:

a. Lead—0.005 or less
b. Cadmium—0.005
c. Bismuth, tellurium—0.001
d. Antimony, arsenic, tin, zinc—0.01
e. Beryllium—indefinite, but probably above 0.02
f. Aluminum—0.1

References

1. R. A. Fisher, *The Design of Experiments,* Oliver and Boyd, (1937).
2. P. R. Rider, *An Introduction to Modern Statistical Methods,* John Wiley and Sons, Inc., (1939).
3. CAST METALS HANDBOOK, American Foundrymen's Association (1944).
4. E. K. Smith, and H. C. Aufderhaar, "Twenty Alloys for Gray Iron," *Iron Age,* vol. 126, p. 1583 (1930).
5. M. M. Ployé, "Influence de l' Aluminum sur les Propriétés des Fontes Ordinaires," *Revue de Métallurgie,* vol. 32, p. 248 (1935).
6. W. H. Spencer, and M. M. Walding, "Effects of Eleven Metals or Alloys on the Physical Properties of Gray Cast Iron," TRANSACTIONS, American Foundrymen's Association, vol. 40, p. 491 (1932).
7. J. E. Hurst, "The influence of Several Less Common Elements When Added to Cast Iron," *Foundry Trade Journal,* vol. 48, p. 137 (1933).
8. W. F. Chubb, "Oxygen in Cast Iron," *Metallurgia,* vol. 9, p. 53 (1933).
9. C. E. Williams, C. E. Simms, and C. A. Newhall, "Tin Slightly Detrimental to Cast Iron," *Foundry,* vol. 52, p. 5 (1924).

Synthetic plastic materials are finding increasing application in the production of patterns and coreboxes. Capable of being cast, like some other materials used in pattern and matchplate construction, certain plastics provide the patternmaker with a pattern easily cleaned and finished. Cast resins machine something like hard maple and woodworking tools may be used. Advantages include rapid duplication of easily drawn, wear-resistant patterns.

Liquid Phenolic Resins for Casting

FOUNDRY PATTERNS

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SYNTHETIC PLASTIC MATERIALS may be used in a variety of ways by patternmakers. By the use of casting resins, the patternmaker can reproduce patterns rapidly and economically for mounting on a matchplate. He may even cast in one piece a plastic matchplate, complete with patterns, gates and runners, the only metal parts being the frame and lugs. Large loose patterns and core boxes may be cast of plastic as well as small patterns and matchplates.

There are many types of plastic materials, so to avoid confusion or misunderstanding, this discussion will be limited to the processing and application of accelerated type liquid phenolic casting resins. The cast resins available today in sheet, rod, tube, and block form, and multi-colored castings will not be considered.

Instead, attention will be confined to the liquid phenolics which, during the past few years, have been welcomed into industry for many basic uses. These include, in addition to foundry applications, forming dies for both hydropress and stretchpress operation, assembly jigs and fixtures, checking fixtures, design and working models, plating shields, masking fixtures, and patterns used in duplicating machines.

Every one of these applications presents an interesting study from the viewpoint of increased production as well as economy.

Casting resins in the main, are of the phenol-formaldehyde type, and their physical properties are similar to those of the compression or transfer molded phenolic plastics. The physical properties chart, Table 1, shows a few basic properties of casting resins. The first column of figures illustrates a composite casting resin, representing the average of specifications of several manufacturers. The resin illustrated is an unfilled material containing 8 per cent of acid accelerator. The percentage of accelerator and the amount of fiber affect the ultimate values for the properties.

In making plastic patterns, the preparation of the mold is the very heart of the whole project. As is well known, anything that is not in the mold will not be in the cast part. Plaster molds are most widely used in practice. However, for certain jobs it may be more practical to use wood, metal, rubber, or plastic molds. It is simpler and faster to use plaster, although a cast resin mold may be desirable if greater resistance to breakage and chipping is desired.

A resin mold must be coated with an acid-resistant paint because without such a coating, a homogeneous unit would result when the plastic mix is poured into the plastic mold. Hardwood naturally makes more satisfactory molds than softwood, but all wood molds should be coated.

A plaster mold requires a coating which serves as a parting agent. The coating may consist of a priming coat and a finish coat of acid-resistant paints.

While the primer is not necessary it is advisable to use it, if a smoother finish on the cast part is desired.

Fig. 1—Plaster mold (left) and the original metal master pattern. Note the detail shown in plaster mold.

TABLE 1.—PHYSICAL PROPERTIES OF PHENOL-FORMALDEHYDE TYPE RESINS
Unfilled Casting Resin with 8 Per Cent Accelerator

Physical Property	Value
Shrinkage from Mold Dimension, in. per in.	0.0025
Rockwell Hardness "R" Scale	115
Flexural Strength, psi	12,000
Compressive Strength, psi, (ASTM)	12,000
Tensile Strength, psi	5,000
Izod Impact Strength—ft. lb. per in. of notch, (ASTM)	0.24
Water Absorption, per cent	0.25
Specific Gravity	1.30

Use of the primer tends to fill out irregularities in porous molds, gives better adhesion, and cuts down the amount of resistant paint required. A very light coating of wax, such as a hard automobile wax, will assure easiest parting.

If a mold is made from an acid-resistant metal such as lead, no protective coating is necessary. Lead molds are definitely the best to use on production runs. If a mold is made of non-acid-resistant metal, a protective coating must be applied. Otherwise the acid accelerator will attack the metal and cause the formation of bubbles and porosity in the cast resin.

Some resins can be cast in rubber or latex molds without the use of any coating material. However, the life of the mold is increased considerably by the application of a light film of lacquer or castor oil.

A newly developed mold material is flexible, soft, and softens only at a high temperature. It may be reused and some moderate tests have shown it capable of remelting fifty times. In the case of undercuts, this new material, rubber, or latex are the only materials practical for molds.

In preparing the plastic for casting, the resin and accelerator and filler, if used, must be weighed carefully before mixing, since only a slight change in proportions will affect the finished product. The temperature of the mixture must be rather carefully controlled within a range which varies with the type of resin and the type and amount of accelerator. If the temperature goes too high the reaction between the resin and accelerator may begin at once and proceed to the final stage without the assistance of additional heat. Usually, when this happens, the reaction goes too fast, ebullition occurs, and the resin froths out of the mold.

Resin and accelerator are always mixed slowly to avoid bubbles. If the mixture has only a few bubbles, these will come out during the period the resin stands at room temperature before it goes in the oven to bake. If too many bubbles are stirred in, they will not escape and the result will be an inferior casting, full of holes where the bubbles were entrapped.

Minimizing Porosity in Cast Resins

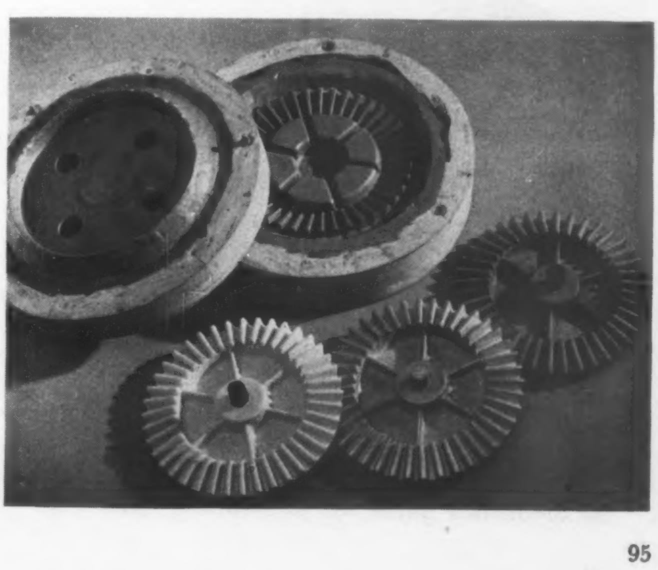
After the mixing operation, the resin should be allowed to remain in the container for 10 to 15 min. to permit any air bubbles to rise to the surface. If a vacuum mixer is available, bubble-free mixtures can be prepared by mixing under vacuum and then stopping agitation before admitting air.

By pouring a resin and accelerator mixture into a

Fig. 2—Paint coating large, loose pattern mold pieces.

Fig. 3—Patternmaker pouring molten resin into mold.

Fig. 4—Wood master pattern, aluminum pattern, cast resin pattern, and the plaster mold of a bevel gear.



mold through one or more layers of an open-weave fabric, trapped air is removed to a large extent. The result is that bubbles and porosity in the hardened casting are greatly reduced. Of course, this would not be practical with resin mixes containing filler, as the fabric would filter out the filler.

The mixture of resin and accelerator must be poured soon after mixing, 15 to 30 min. being the usual practice. The mixture should be poured slowly into the mold to prevent formation of air bubbles and subsequent pores in the finished casting.

Baking Temperature Control

After pouring the prepared mixture into the mold, baking is necessary to cure the resin and to make it hard and strong. The curing cycle depends on the volume of the resin, the amount of accelerator and the thickness and heat-transfer characteristics of the mold. As the resin sets, it becomes opaque and gelatinous and finally takes on a creamy appearance as it reaches its final hardness. The state of cure may be judged roughly by the appearance.

Control of temperature during baking is vitally important. Ovens should be checked to assure uniformity of temperature throughout. Even with an automatically controlled oven it is good practice to hang a thermometer in the oven very near the casting. It should read from 138 to 142 F. Higher temperature may cause foaming.

If the casting is soft and pliable when removed from the mold, it is still uncured. It must be completely cured and hard before removing from the oven. After curing, the color of the resin should be yellow. If an orange color develops, it is an indication of over-cure caused by too much accelerator or too high a temperature. When fast baking is required a higher percentage of accelerator and a higher baking temperature may be used for small pieces with thin sections.

Fillers may be added to the resin but in general they lower the strength of the cured plastic due to the formation of a weaker structure. For example,

Fig. 5—A match plate pattern. The oarlocks and gates and runners of this pattern are made of cast resin.

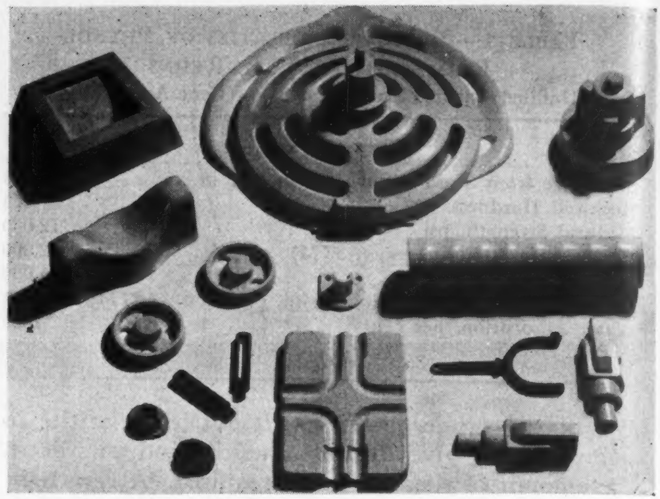


Fig. 6—A group of patterns illustrating the wide range of sizes and shapes possible with casting resins.

the addition of 20 per cent walnut shell flour reduces the flexural strength of a casting about 30 per cent. The use of a special asbestos materially reduces shrinkage. However, only small quantities can be added to the resin without encountering difficulty in making a solid casting, due to the fluffy nature of the asbestos. The addition of asbestos filler improves heat resistance and minimizes cracking due to thermal shock from rapid alternate heating and cooling.

Shrinkage as low as 0.001 in. per in. has been obtained with a mixture containing 8 per cent accelerator to which was added 5 per cent asbestos and 3 per cent boric acid. The asbestos and boric acid content were calculated on the combined weight of the resin and accelerator. The boric acid was first heated 4 hr. at 300 F to remove the water of crystallization.

Machining of Cast Resins

Cast resins machine about like hard maple and, in general, woodworking tools may be used. However, if many pieces are to be machined, carbide-tipped tools are recommended. Data on workability and finishing of cast resins may be obtained from standard handbooks and other sources. Usually very little finishing of plastic patterns is required although some uneven surfaces may have to be smoothed with a file, scraper and sandpaper. Porosity or surface defects may be easily patched with a small amount of resin containing about 15 per cent accelerator.

The savings effected through the use of cast plastic patterns are shown by examples of the commonest case—that of duplicating existing patterns. In one instance, a wood pattern costing 175 dollars was duplicated to meet production requirements. The duplicate was made in a plaster mold in less than 24 hr. and at a cost of 25 dollars. In another case, a patternmaker compared the costs of duplicating a bevel gear pattern requiring 3 lb. of aluminum alloy, 16 hr. finishing time and three sheets of emery cloth. To produce the cast resin pattern required 5 lb. of plaster, $4\frac{1}{2}$ hr. to make the mold and mix the resin, $1\frac{3}{4}$ lb. of resin, $\frac{1}{4}$ sheet of sandpaper and a few spoonfuls of paint to coat the plaster mold. Additional patterns required only $1\frac{3}{4}$ lb. of resin and $1\frac{1}{2}$ hr. time.

FOUNDRY TRAINING COURSE FOR COLLEGE GRADUATES

Subcommittee Report on Training Graduate Engineers in Industry

American Foundrymen's Association Educational Division

INDUSTRIAL FOUNDRY TRAINING of college graduates is receiving increasing attention as more and more foundries recognize the contributions graduates can make to the industry. In addition, college graduates look to the castings industry for a career because they are beginning to recognize the opportunities available and the absence of competition in this field.

During the war years, most engineering graduates were in the armed services. Consequently, it was difficult to secure and train the young technical talent which the castings industry urgently needs now. The technical staffs of foundries which formerly used many college graduates, and the personnel of foundries planning to use graduates for the first time, will have to be built up of young men who are now being graduated. Some of these men had some industrial foundry experience during the war, and many of them are veterans who learned of the importance of the castings industry through its war efforts.

Graduates Need Training

Some of these graduates are interested in foundry work and expect the industry to give them industrial training to fit them to take their place in an important basic industry. It is important that the castings industry recognize, as has many other industries, that college graduates need industrial training, as well as desire it. A college graduate, like a graduate of any other course in formal education, has merely been prepared to absorb information and ideas and correlate them with known information rapidly and thoroughly. If properly educated in college and if he has the proper outlook, a college graduate can contribute much to an industrial enterprise, after he has become acclimated to industrial life and practices.

Opportunities in the castings industry for the college graduate have been discussed previously in publications of the American Foundrymen's Association. The value of a college graduate to a foundry has also been brought out. Both of these subjects were covered particularly well in an article entitled "College Graduates and the Casting Industry" which appeared in the November, 1946, issue of AMERICAN FOUNDRYMAN. Reprints of this article are available to graduates, foundry management, personnel managers and to all who are interested.

The function of a foundry training course for college graduates is to effect a combination of industrial foundry experience and college education which will make a man more valuable to a plant than if he had only one of these two types of training. The possibility of giving a college education to a practical foundryman should be considered, as well as the reverse procedure of making a foundryman out of a college graduate.

Complete college training of foundry apprentices is being carried on by the University of Wisconsin in cooperation with the Wisconsin Chapter of A.F.A. Under this plan, several foundry apprentices, who are interested and able to meet college entrance requirements, are selected each year from Wisconsin foundries. These apprentices attend the University full-time, take a course in metallurgy or engineering, and earn part of their expenses by serving as laboratory assistants in the foundry and metallurgical laboratories. Such a plan is well worth consideration by other chapters and by the larger foundries.

A.F.A. Educational Division

The foundry training course for college graduates outlined later, and the suggestions regarding its establishment and execution, were prepared by the Training of Graduate Engineers within Industry Subcommittee of the former Committee on Cooperation with Engineering Schools. The functions of these committees have been assumed by others in the newest A.F.A. division, the Educational Division. The membership of the subcommittee included Chairman A. W. Gregg, Executive Engineer, Equipment Division, Whiting Corporation, Harvey Ill.; G. J. Barker, Chairman, Metallurgy Department, University of Wisconsin, Madison; H. Bornstein, Director, Testing & Research Laboratories, Deere & Company, Moline, Ill.; and C. V. Nass, Vice President and Manager, Foundry Division, Pettibone Mulliken Corp., Chicago.

Training Course Varied

A recommended course of training for the college graduate in the foundry must of necessity be quite general because no schedule will be applicable to all conditions and all foundries. Therefore, foundry management planning such a course should have definitely in mind the positions for which these young men are being trained.

The program suggested must be varied somewhat to fit a man's college training and the needs of the foundry. The course should be open to graduates of recognized colleges and universities. It might be preferable to confine the course to engineering school graduates although graduates holding degrees other than engineering or metallurgy might well be considered for certain positions.

In planning the course, it must be kept in mind that the college graduate is not being trained to be

Courtesy Allis-Chalmers Mfg. Co.
Milwaukee, Wisc.

Pattern instruction by the training course supervisor.

a mechanic. Nevertheless, he must secure sufficient knowledge of all branches of foundry work to be able to understand them and correlate them. If he has the ability and patience, a properly trained college graduate may secure a top position such as superintendent, works manager, sales manager or chief metallurgist.

Nothing less than a well planned 18 months course, and preferably two years, will provide sufficient time for proper training. Perhaps eighteen months of this time should be spent adhering to a rather definite schedule, and the last six months spent on special assignments under the supervision of the head of the department to which the man will be assigned on completion of his training period.

It is highly important, no matter what course of training is adopted, that the prospective trainee understand exactly what his program will be. If the company has a training supervisor, he is the man to whom the graduate should be responsible. The supervisor should see that the man is moved from department to department according to schedule.

Hold Weekly Meetings

If the company has no training supervisor, someone in authority, such as the works manager or the general superintendent, should assume this responsibility. The supervisor of graduates should be a man of broad experience with a genuine liking and sympathy for young men. He should be a kind of father confessor to whom the young man will feel free to confer concerning any problem or trouble which may be encountered.

A weekly meeting of graduates with the supervisor is a valuable means of checking each man's progress and understanding of the work of his department. Each graduate should be required to submit a written report as he completes his time in a department, describing what he has learned, and making observations and suggestions about the operations in the department.

Graduates should be encouraged to join the American Foundrymen's Association and to attend chapter meetings. Most foundries hold weekly foremen's meetings in which current problems of the foundry are discussed by supervisors and management. During the latter part of his training, it is well to have the graduate attend these meetings.

The wage paid to the college graduate will be variable because conditions vary from one locality to another, and from year to year. However, the wage should be sufficiently attractive to interest the graduate and he should be given an encouraging increase in pay every six months. He should also be given a salary increase upon completion of the training course.

Orientation Period Needed

When the man first reports for duty he should be introduced to foremen and executives of the company, and should be given two or three days (or possibly a week) to observe the various operations throughout the plant. This will enable him to get used to an industrial plant and to get an over-all picture of operations. After this brief period of orientation, the trainee should be started on a prescribed course. An outline of a course for training college graduates in the castings industry follows.

Industrial Training Outline

Pattern Shop—Five Weeks. The graduate cannot be expected to make patterns and will be of little value as a helper. However, a great deal can be learned by watching a skilled pattern maker, and by studying the rigging which is developed in this department. The pattern shop is often the planning department of the modern foundry.

The graduate can be asked to do design work and estimate costs in pattern making. He should spend considerable time checking patterns in and out of pattern storage and to and from the foundry. Patterns are often abused in the foundry and the engineering apprentice should note the condition in which patterns are returned to storage. He should note also how the condition of patterns affects production and the number of scrapped castings.

Molding Department—Fifteen Weeks. The graduate should have experience with floor molding, bench molding, machine molding, molding sands, sand conditioning, sand testing, etc. He should help molders making heavy floor work, and should make some small simple molds on a bench and on a molding machine. If the molding department is mechanized, he should be moved from one job to another in this department. He should also get some experience in pouring.

Core Room—Ten Weeks. This department is very important in some foundries and relatively unimportant in others. The time spent in the core room should be regulated accordingly. The graduate can be trained in a short time to make small cores on a bench. If the foundry uses large and intricate cores, he should spend time helping a core maker on this class of work.

The trainee should study core sands and binders, mixing of core sand, and the composition of various core mixtures. The time and temperature required to bake cores made with different binders should be studied as well as the design and operation of the ovens, core blowers, etc.

Studies Rejection Causes

Finishing Department—Five Weeks. The trainee should not be used as a chipper, grinder, welder, flame cutter, etc., but should study these operations sufficiently to become thoroughly familiar with them. He should pay *especial attention* to castings which are scrapped and study thoroughly the reasons for rejection. If the inspection of castings is under a separate department, the apprentice should be assigned to the inspection department for at least five weeks.

Melting Department—Fifteen Weeks. The graduate can be useful in this department in many ways, and it is important that he become familiar with all the operations and the equipment and furnaces. He should make a thorough study of the theory and practice involved and of the metallurgical reactions in the melting units. He can assist in making up and weighing charges and in repairing the refractory linings of the melting units. He should familiarize himself with the various refractories, the results obtained with various fuels and the handling of alloying materials.

Laboratory and Testing Departments—Fifteen Weeks. In these departments, the graduate is generally on familiar ground. Here his time should be divided between the chemical, the mechanical testing, the sand control, the pyrometry, the x-ray and the metallurgical laboratories.

Cost Experience Essential

Cost and Estimating Departments—Ten Weeks. The trainee who is expected to fill an executive position at some future time must have an idea of the cost of operating all departments. In addition, a thorough understanding of the cost system employed is essential. Ten weeks spent in the cost and estimating departments will be of some value in acquainting the graduate with a phase of business generally neglected in engineering curricula.

Specialized Training—Six Months. After spending approximately 18 months in the various foundry departments the graduate should be familiar with all operations of the foundry, and should have a well-founded opinion regarding which part of the business attracts him most. In addition, the plant management should have become acquainted with the man's aptitude and ability.

The final six months should be spent in specializing in the work in the department in which the man is most interested and in which he will be expected to work after training. If he is particularly interested in planning and general operations, the balance of his time should be spent under the works manager.

For a graduate interested in manufacturing, some time should be allotted to the plant maintenance department which represents an important item in the overhead cost of making castings.

In case a graduate is interested in engineering, he should be assigned to the engineering department under the supervision of the plant engineer. This department often has charge of maintenance and is responsible for the purchase of new equipment, building extensions, etc.

Many college graduates will prefer to get into sales work. If so, they should be assigned to the sales manager, who will train them in sales work. A special course in salesmanship would be advisable.

Those who prefer metallurgical and laboratory work should be assigned to the chief metallurgist. In general, however, laboratory work in the last six months should be discouraged as a means for developing foundry engineers.

Typical Training Program

A typical good training program for college graduates in the castings industry is shown in the course of the Falk Corporation of Milwaukee. This program requires eighteen months (3,120 hours), and the schedule is as follows:

Assignment	Time — Hr.	Time — Equivalent Weeks
Inspection Department	300	7½
Small Molding—Centrifugal Casting	400	10
Large Molding Floor	600	15
Chipping—Welding—Gas Cutting	200	5
Chemical and Metallurgical Laboratory	300	7½
Large Core Room	200	5
Sand Control Laboratory and Foundry Research	600	15
Small Core Room	200	5
TOTAL	2800	70

The balance of the time is spent in the Standards and the Heat Treating Departments, in Sand Reclamation, Production or any and all of the above mentioned departments.

The larger independent and captive foundries have programs for training graduates of colleges similar to one suggested in this report and the Falk Corporation course. Programs of this type are also used in the smaller plants which hire college graduates at the rate of one a year or less frequently.

Subcommittee Personnel

Since the formation of the Education Division of A.F.A., the task of developing and broadening courses for industrial training of college graduates has been taken up by the Engineering Apprentice Training Subcommittee under the chairmanship of C. V. Nass, Vice-President and Manager, Foundry Division, Pettibone Mulliken Corporation, Chicago. Other members of this Subcommittee are H. Bornstein, Director, Testing and Research Laboratories, Deere & Company, Moline, Ill.; Professor G. J. Barker, Chairman, Department of Metallurgy, University of Wisconsin, Madison, and Richard W. Heine, Instructor, General Motors Institute, Flint, Mich.

COSTS AND PRICING

G. R. Targett
Treasurer
Sibley Machine & Foundry Corp.
South Bend, Ind.

KEY FOUNDRY OPERATING FACTORS

THE FOUNDRY INDUSTRY, as a whole, has made tremendous progress during the past few years in the improvement of plant facilities, including a great amount of mechanization. The industry is to be congratulated upon this advancement, but it is realized that only a start has been made in the proper direction; that the progress made is by no means complete and will be used as a base for further accomplishments.

In far too many instances, the progress made in the plant itself has not been matched by improved accounting methods, which are essential if management, supervisors and foremen are to obtain adequate information regarding the results of plant operations. It is not the intention to tell foundrymen how to keep a set of books. There are, however, many phases of accounting in which the foundryman should be vitally interested because the information that can be obtained from improved foundry accounting is absolutely essential for the proper performance of his job.

Casting selling prices, of course, definitely determine whether or not operations are profitable. In addition to this, they have a real bearing on the type of work that goes into each plant, and can even be a decided factor in determining the type of pattern equipment supplied by the plant's customers. There are three general methods of pricing commonly used:

1. Per ton or per pound price for all castings produced for each customer from all of the customer's patterns.
2. Per pound price for castings produced from individual patterns.
3. Piece price for castings produced from individual patterns.

The first method mentioned was, perhaps, the most generally used by foundries several years ago, but it is hoped that none are using it now. It has many disadvantages for both customer and foundry.

From the customer's point of view, the chief disadvantage is that the per ton or per pound average selling price does not give him the true cost of any particular casting or group of castings and, since he is forced to use the average per pound price, the computed cost of any of his finished parts may be either understated or overstated.

The result is that he really does not know the actual cost of any of his finished products. His established selling price for each product, being based on an erroneous casting cost, may be either too high or too low, and places him at a disadvantage with any of his competitors who can determine actual costs and establish their selling prices accordingly.

From the foundry's point of view, there are several disadvantages to this pricing method, even though the over-all average price for estimated production from each of the customer's patterns is adequate. If a large number of patterns are involved, production will certainly vary from month to month.

During months when mostly low-cost patterns are run, operating profits will appear to be exceptionally good, but during months when more of the high-cost patterns are used, operating profits may appear to be low or even show a loss. This pricing method, therefore, cannot be expected to show true operating results from month to month, and no one will be able to definitely determine the exact reason for these monthly profit fluctuations.

The most dangerous thing connected with average per ton or per pound pricing is that most customers are forever on the lookout for a cheaper source of supply. Obviously, any considerable number of patterns will contain some from which castings can be produced cheaply and some from which production is expensive.

Low-Cost Patterns

If the casting buyer shops around, he can probably locate sources willing to produce and sell certain castings at considerably less than the over-all average price. One by one, these low-cost patterns will disappear from the plant, and eventually the plant will be producing only the expensive castings and selling them at a considerable loss.

When this method of pricing is used, there is no incentive for the customer to furnish improved pattern equipment for any particular casting since, from his point of view, he would only be incurring additional pattern expense without any chance to recover this expense through decreased casting costs.

The second pricing method mentioned, that of having a per pound price for castings produced from individual patterns, is satisfactory from the standpoint of the foundry provided an accurate average weight for each casting is available from previous shipping records or can be obtained by other means.

It does have one decided disadvantage from the customer's point of view, since there is certain to be some variation in the average weight of the same casting in different shipments. This means constantly changing cost prices which will not permit the customer to use a standard per casting cost and requires considerable clerical work to make changes in cost records each time a shipment of castings is received.

In addition, the buyer probably sees no reason why

he should pay $10.15 for a casting in one shipment and $10.45 for the same casting in another shipment, since their value to him as a part of his finished product is exactly the same.

The third pricing method mentioned, that of having a dollar and cents piece price for castings produced from individual patterns, is the best possible pricing method from the standpoint of both the foundry and the customer. To be of value to both, individual piece pricing must, of course, be based on accurate individual costs by the foundry. The manner in which these costs can be determined will be discussed later.

When the individual piece price method is used, the total sales price of castings produced during a weekly or monthly period will fluctuate in direct proportion to high or low operating costs caused by the particular type of castings produced during the period, and profits will remain fairly stable from period to period.

This method gives the customer the true cost of each casting and he can, therefore, determine the true cost of his finished product. This enables him to concentrate his production and sales efforts on products which can be sold at a profit. This will ultimately benefit the foundry by making possible larger orders from the customer for those particular castings with a corresponding reduction, or entire elimination, of other castings.

Eventually, the foundry will be able to sell the customer the same or a greater quantity of castings but will require a smaller number of patterns. Larger runs from each pattern usually mean reduced costs, which will result in greater profits since the selling price remains unchanged.

Another advantage of this method is that usually the best possible type of pattern equipment can be obtained from the customer, because at least a part of the savings resulting from the use of such equipment can be passed on in the form of a reduced selling price.

New Pattern Equipment Desirable

In most cases, the possible reduction in selling price will pay for the improved equipment over a reasonable period of time. In this way, the usual task of convincing a buyer of the desirability of new pattern equipment is made much easier. When the best type of pattern equipment is obtained, production per molder is always increased and scrap losses usually are reduced.

In order to establish a pricing formula which can be used to compute individual casting selling price, it is essential to have a cost system which will enable the foundryman to obtain detailed and accurate information relating to the production cost of any individual casting or group of similar castings.

For this purpose, and also for better control of operating costs, it is desirable to break down total costs into the smallest possible cost units. This enables us to combine all of the cost units that actually belong in the total cost of any particular class of castings, and to exclude any cost elements not related to that type of production.

The first step toward complete cost analysis is to divide the various foundry operations into separate departments. The most simple plan consists of assigning numbers to each department. A small foundry producing only one general class of castings could be easily divided into five departments.

Department No. 1 would include all operations required to melt the metal and to deliver it to the molders. Department No. 2 would include molding and related operations such as pouring, shifting, shakeout and sandcutting. Department No. 3 would include all coreroom operations. Department No. 4 would include cleaning, grinding, inspection, and shipping. Department No. 5 would include all general plant costs such as maintenance, supervisory and clerical.

A large foundry melting several types of iron and producing more than one general class of castings would require many more departments in order to accurately accumulate the costs pertaining to the production of one particular class of castings.

These might include one for each cupola operated, one for iron delivery to the molders, as many as are required to divide molding operations by casting classifications, a sufficient breakdown of coreroom operations to provide one department for each molding department requiring core production, one for shifting, one for shakeout, one for sandcutting, and one for casting delivery to the cleaning room.

Department Subdivision

Cleaning and finishing operations could be divided to provide separate departments for tumbling, milling, sandblasting, grinding, inspection and shipping. In some cases it might be desirable to subdivide one general operation, such as grinding, to provide separate departments for work on each class of castings.

Other departments might be provided for any special type of work such as annealing, plant maintenance, patternmaking and repairs, flask making and repairs, production control and first aid. It usually is desirable to assign one department number to cover general plant expenses which cannot be accurately charged to individual operating departments.

If numbers within the series 1 to 99 are used for department numbers, other series of numbers can then be used to designate various classifications of expense. For example, 100 might be assigned for direct labor, 200 for indirect labor and 300 for operating supplies.

Numbers should be assigned to cover all classes of expense. This method enables quick classification of any expense item by using the proper classification number with a prefix number to indicate the department to which it should be charged. In this way, all operating costs can be accurately accumulated for each department.

All materials and supplies should be charged to inventory accounts when purchased, and requisitioned as accurately as possible when used. Pig iron, scrap iron and shop scrap should be weighed when cupola charges are prepared to provide consistency in iron analysis and to insure accurate material costs.

Shop scrap usually can be ignored in the average foundry as a factor in metal costs, since ordinarily it is re-melted the following day and is not allowed to accumulate. Supply requisitions should indicate the department to which they should be charged.

Fixed expenses must also be accurately allocated in order to obtain exact departmental costs. Charges for depreciation and property taxes on equipment should be based on the value of the equipment used in each department. Depreciation and taxes on buildings may be distributed on the basis of floor space used.

Electric power costs can be distributed with some degree of accuracy bv determining the total horsepower of motors used in each department, as compared with the total horsepower of all motors throughout the plant. Taxes and insurance premiums based on payrolls should be charged on the basis of the total wages charged to each department.

During the period of price controls, each foundry was required to file a pricing formula and use it to establish selling prices on all new work. Due to the fact that many foundries had not actually been using an exact pricing formula, this requirement was the cause of much confusion within the industry and resulted in many misunderstandings.

Establishing Pricing Formulas

In the average foundry producing castings in several general classifications, not one but several pricing formulas must be established in order to accurately price each casting within each general group. Usually, one pricing formula will be required for each molding department, set up as previously mentioned to include only one general class of castings.

The most simple type of pricing formula would include three factors based on previous cost experience during a period of normal operations. These are:

1. Cost of metal at spout per pound of good castings.
2. Molding overhead percentage to direct molding labor.
3. Core overhead percentage to direct core labor.

Cost of metal at spout per pound of good castings would represent the sum of all material, supply, labor and expense costs charged to the melting department, plus its share of general plant expense, divided by the total pounds of good castings obtained during a specific period.

Molding overhead percentage to direct molding labor would represent the sum of all supply, expense and labor costs, excluding direct molding labor itself, charged to the molding department, plus its share of general plant expenses, and plus total cost of cleaning, grinding, inspection and shipping, and divided by the total direct molding labor paid during a period.

Core overhead percentage to direct core labor would represent the sum of all supply, expense and labor costs, excluding direct core labor itself, charged to the core department, plus its share of general plant expense, divided by the total direct core labor paid during a specific period.

In using a simplified pricing formula as described, it would be necessary to determine only three variable factors in order to establish an individual casting selling price. These three factors are:

1. Weight of the casting.
2. Direct molding labor per good casting.
3. Direct core labor per good casting.

The casting cost would be determined by multiplying the casting weight by the predetermined cost of metal at spout, plus the direct molding labor per casting, plus the previously determined molding overhead rate applied to this figure, plus the direct core labor per casting, and plus the previously determined overhead rate applied to this figure. To determine the proper selling price, this cost figure would be increased by a percentage to cover sales and administrative expense, and by a percentage to return the desired profit rate.

Defective Casting Costs

Direct core labor included in this formula is not the direct labor cost per core, but the direct core labor cost per good casting which, in the average foundry, is about 10 per cent higher than the rate per core due to core breakage and loss of cores in defective castings. Other defective casting costs are automatically included in the molding overhead percentage unless it is expected that the defective percentage on the particular casting being priced will exceed the plant over-all average, in which case an extra percentage of cost must be added to cover the extra cost caused by excessive scrap.

While this type of pricing formula will work quite satisfactorily in most foundries, in some cases it may be desirable to establish a more detailed formula. This can easily be done by omitting certain operations from the molding overhead percentage computation and including these operations as separate items in the formula, assessing their costs on a per pound or per casting basis.

Any operations such as grinding or inspection performed on a piecework basis should be excluded from the general overhead percentage and added as separate items, plus their proper overhead percentages. Any items of cost applying to some but not all castings produced may also be handled as separate items.

Conclusion

Free competition between foundries for the available business is certainly desirable, but too often in the past the foundries that did not know their costs and did not consider the production problems involved have, to a considerable extent, established selling prices for the entire industry by quoting low prices which would have ruined them had they obtained the business.

It is imperative that quoted prices be based on a thorough understanding of production costs for individual castings and, if prices are quoted in this manner, each foundry will then be on a truly competitive basis. The foundry that is able to operate most efficiently will have the lowest costs and will be able to legitimately quote the lowest selling prices.

All foundry supervision, including foremen, must be made cost conscious so that they will understand why it is necessary to properly report all items of cost to the end that proper selling prices can be accurately determined, and so that they will constantly be on the lookout for possible improvements in methods and equipment to reduce operating costs. This will lead to accurate costing, to improved operations, and to increased production capacity.

CONVENTION POINTS

(*Continued from Page 47*)

At random in and around the convention halls in Detroit. 1—(Left to right) F. J. Dost, Sterling Foundry Co., Wellington, Ohio; E. W. Horlebein, Gibson & Kirk Co.; and W. L. Seelbach, Superior Foundry, Inc., Cleveland. 2—(Left) E. W. Beach, Campbell, Wyant & Cannon Foundry Co.; and C. O. Bartlett, C. O. Bartllett & Snow Co. 3—(Left to right) E. C. Zirzow, National Malleable & Steel Castings Co.; D. F. Sawtelle, Malleable Iron Fittings Co.; and D. Tamor, American Chain & Cable Co. 4—(Left to right) K. E. Davis, Cadillac Motor Div., General Motors Corp.; L. L. Clark, Buick Motor Div., General Motors Corp.; and J. H. Bernard, Eaton Mfg. Co. 5—(Left to right) R. F. Harrington, Hunt-Spiller Mfg. Co., Boston; B. L. Simpson, National Engineering Co., Chicago; and Arnold Lenz, General Motors Corp., Detroit. 6—(Left to right) S. N. Iyengar and E. S. Rao, Premier Automobiles, Bombay, India; and J. V. Patel, New Standard Engineering Co. Ltd., Bombay. 7—(Left to right) A. W. Gregg, Whiting Corp.; Dr. R. L. Lee, General Motors Corp.; and F. G. Sefing, International Nickel Co. 8—(Left to right) W. W. Levi, Lynchburg Foundry Co.; J. E. Coon, Packard Motor Car Co.; and E. J. Burke, Hanna Furnace Corp. 9—(Left to right) Fred J. Walls, International Nickel Co.; George Christopher, Packard Motor Car Co.; A.F.A. President S. V. Wood, Minneapolis Electric Steel Castings Co.; and Detroit Chapter Chairman A. H. Allen, Penton Publishing Co. 10—(Left to right) R. H. McCarroll, Ford Motor Co.; H. W. Dietert, Harry W. Dietert Co.; S. D. Russell, Phoenix Iron Works, San Francisco; and F. M. Wittlinger, Texas Electric Steel Casting Co., Houston. 11—(Left to right) H. S. Simpson, National Engineering Co.; Joseph Sully, Sully Foundry Div., Neptune Meters Ltd.; and Rodney Washburn, Plainville Casting Co.

C. F. Joseph of the Central Foundry Division, General Motors Corp., Saginaw, Mich., presided at the opening session April 28. W. D. McMillan of the International Harvester Co., Chicago, was Co-Chairman.

Failure to consider problems of "*Malleable Iron Finishing*" in planning castings production leads to excessive costs and lower profits declared Earl M. Strick of the Erie Malleable Iron Co., Erie, Pa.

Best results can be achieved through cooperation between the pattern, foundry and finishing departments, he continued. The chief inspector should be familiar with customer requirements if unnecessary and costly finishing operations are to be avoided. Proper finishing of malleable iron castings involves

attention to hard iron cleaning and inspection, maintenance of peripheral speeds of grinding wheels in the face of decreasing wheel diameters, use of shearing equipment, where applicable, and chipping.

Following soft iron cleaning, straightening and final inspection should be carefully completed, he said. A study of each casting must be made to arrive at the best combination of finishing operations.

In the discussion at this meeting, interest centered in the operation of grinding wheels with members asking numerous questions about accident rates and costs attending the use of the equipment. The question of speed of operation entered the discussion, many expressing favor for "high" speed operation over "low" speed.

In a report covering *"Malleable Foundry Finishing and Inspection,"* T. Earl Poulson of the Belle City Malleable Iron Co., Racine, Wis., pointed out that the foundry industry today is being asked to produce castings with tolerances which only a few years back would have been classed "impossibly close."

The foundry is also asked to produce castings which may be used without machining as running parts of operating equipment, he added. This condition calls for the foundrymen's best effort if customers' needs are to be met at low cost.

In a plant described by Mr. Poulson inspection control in the production of malleable castings starts with the arrival of the blueprint and the request for quotations and ends at the customer's plant.

With R. J. Anderson of the Belle City Malleable Iron Co., Racine, Wis., as Chairman and J. A. Durr of the Albion Malleable Iron Co., Albion, Mich., as Co-Chairman, the second technical session on Malleable Foundry Practice convened the afternoon of April 28.

Mechanized Handling

In a presentation entitled *"Material Handling in a Malleable Foundry Processing Department,"* specific application of the principles of mechanized handling were outlined by N. J. Henke of the Central Foundry Division, General Motors Corp., Saginaw, Mich.

Foundrymen should realize that without adequate and efficient handling methods in the processing department, the most effective practices of economy in the foundry are useless, Mr. Henke declared.

Economic material handling is obtained by the use of transporting equipment that is capable of being used for a variety of operations, he said. Such equipment should be designed to permit its effective use under changing conditions and varying rates of production.

Mr. Henke's presentation of his subject was effective. A large delegation of his co-workers attended.

Finishing Operations

Continuing the theme of mechanized handling which featured the session, D. F. Sawtelle of the Malleable Iron Fittings Co., Branford, Conn., described finishing operations in a mechanized malleable foundry, from mold shakeout to finished casting. Title of his address was *"Mechanized Malleable Foundry Finishing and Inspection."*

In the plant described by Mr. Sawtelle two tumbling barrels, arranged in tandem, automatically load and discharge as well as cool and clean castings before transferring them to a conveyor belt. The belt conveys the castings to two men stationed near the cupola where the sprues are removed and placed in a storage bin.

The third session on Malleable Foundry Practice was held April 29 under the Chairmanship of V. A. Crosby of the Climax Molybdenum Co., Detroit. Milton Tilley of the National Malleable & Steel Castings Co., Cleveland, was Co-Chairman.

"An Interpretation of the Constitution of Iron-Carbon-Silicon Alloys" was the title of a report made by J. E. Rehder, metallurgical engineer of the Bureau of Mines, Ottawa, Canada at this meeting.

Review of experimental data on the ternary system iron-carbon-silicon alloys leads to the conclusion that iron-carbon-silicon alloys, at least in the range of zero to four per cent carbon and zero to four per cent silicon, act as though the silicon is all present as dissolved Fe_3Si, with the iron and carbon acting as a pure iron-carbon alloy, Mr. Rehder said. He suggested that similar reasoning can be applied to the low phosphorus range of iron-carbon-phosphorus alloys.

Describing studies made on *"Graphitization of White Cast Iron,"* D. J. Reese of the International Nickel Co., New York, and Richard Schneidewind and A. Tang of the University of Michigan, said the time required for first-stage annealing of sections of white iron step bars indicated that the cooling rate of the casting during solidification had a great effect.

The cooling rate was considered to be proportional to the ratio of volume to surface area of the casting. It was found that the logarithm of this ratio is directly proportional to the logarithm of annealing time and to the grain size of the metal.

Winding up the Malleable program for 1947, A. M. Fulton, Northern Malleable Iron Co., St. Paul, Minn., presided at a Round Table luncheon April 29, with J. H. Lansing, Malleable Founders' Society, Cleveland, assisting. The discussion leader was C. F. Lauenstein, Link-Belt Co., Indianapolis, Ind., and discussion revolved mainly around three practical subjects of current interest — *"Chromium Determinations," "Grinding of Malleable Gates,"* and *"Exothermic Ladle Additions."* The latter subject in particular induced numerous questions on the application of exothermic products to gating and risering.

ALUMINUM & MAGNESIUM

OPENING TECHNICAL session sponsored by the A.F.A. Aluminum and Magnesium division, April 28, brought out reports on both light metals. W. E. Sicha of the Aluminum Co. of America, Cleveland was Chairman of the meeting and J. C. DeHaven of Battelle Memorial Institute, Columbus, Co-Chairman.

"Influence of Inclusions on Properties of Sand Cast Aluminum-Base Alloys," a report based upon investigations made on cast aluminum alloys at Case Institute of Technology, Cleveland, was presented by G. Sachs, A. W. Dana, and L. J. Ebert, metallurgists.

Among six common aluminum-base alloys studied, the CN21 alloy was most prone to form inclusions while the S2 alloy formed the least. The alloys, in order of tendency to

Steel Round Table Luncheon head table consisted of (left to right) S. W. Brinson, Norfolk Navy Yard, Portsmouth, Va.; A.F.A. Secretary-Emeritus R. E. Kennedy, University of Illinois, Chicago; C. H. Lorig, Battelle Memorial Institute, Columbus, Ohio; H. H. Blosjo, Minneapolis Electric Steel Castings Co.; E. C. Troy, Dodge Steel Co.; F. A. Melmoth, Cedar, Mich.; John Howe Hall, Swarthmore, Pa.; A. H. Jameson, Malleable Iron Fittings Co.; C. W. Briggs, Steel Founders Society; C. E. Sims, Battelle Memorial Institute; and G. A. Ziegelmueller, Electric Steel Castings Co., Indianapolis.

form inclusions, were (1) S2 (2) C2, (3) CS22, (4) C1, (5) SC21, (6) CN21.

The investigators reported that presence of inclusion reduced the tensile strength of the alloy by causing a premature termination of the stress-strain curve. Inclusions which extended to the surface of the cast test bar were found to cause a greater reduction in strength than those which were wholly in the bar.

At the same session, some studies of *"Causes of Pinholes in Magnesium Alloy Castings"* made by H. H. Fairfield (now of H. W. Dietert Co., Detroit) and A. E. Murton, metallurgical engineer, at the Bureau of Mines, Ottawa, Canada, were discussed. About 700 flat castings were made in this investigation.

Pinhole Formation

On the basis of their studies the speakers concluded that all factors which tend to increase mold gas pressure also accelerate pinhole formation. Pinholes are increased by lowering permeability, raising moisture, and increasing mold hardness. Other conclusions reported were:

Dried molds give markedly fewer pinholes than do green sand molds;

Moisture or hydrogen absorbed in melting cause pinholes;

Chlorine fluxing reduces the tendency to form pinholes and clayballs have been shown to cause the same defect;

Pouring speed has a pronounced effect upon pinhole formation;

Sulphur, boric acid, and di-ethylene glycol additions to the molding sand inhibit pinhole formation.

At the second Monday session, R. E. Ward of the Eclipse-Pioneer Div., Bendix Aviation Corp., Teterboro, N. J., presided as Chairman with W. A. Mader, Oberdorfer Foundries, Syracuse, as Co-Chairman of the session.

Room Temperature

R. A. Quadt, research metallurgist of the American Smelting & Refining Co., Perth Amboy, N. J., presented a report on the *"Effect of Room Temperature Intervals Between Quenching and Aging of Aluminum Sand Casting Alloys."* The period of time elapsing between quenching and artificial aging may vary due to practical but nonmetallurgical considerations and the effect of room temperature intervals on these alloys was studied recently by Mr. Quadt.

Intervals at room temperature at which castings were held, prior to "artificial aging" at 310 F, were 30 minutes, 24 hours, and one week. These intervals had no effect upon the aging characteristics of commercial 4 per cent copper alloys, Mr. Quadt declared. Casting alloys in which Mg_2Si is the principal hardening compound, however, are markedly affected by room temperature aging.

For the two alloys studied, this research indicates that elongation is improved if castings are allowed to age one day at room temperature before artificial aging is applied. Immediate artificial aging develops high strength and hardness at the expense of elongation.

E. V. Blackmun of the Aluminum Co. of America, Cleveland, reported an investigation on *"Impregnation of Aluminum and Magnesium Castings"* at this meeting. Where limitations imposed on the designer or foundry are such that certain casting areas cannot be cast pressure tight, impregnation with sodium silicate or thermo-setting materials is necessary, he declared.

Impregnation should not be considered a method for salvaging structurally faulty castings, nor as an expedient to maintain production rates with lower quality, he said. When correctly used, impregnation methods do avoid the loss of serviceable castings, he continued.

"The common sodium silicate solution possesses the attributes of a good impregnating material," said Mr. Blackmun. "Styrene-resin impregnants possess the same characteristics and may be used to seal a very fine leakage encountered in some aluminum alloys and in several magnesium alloys.

"After testing, direct pressure application to large castings and batch pressure application to small castings are often used. A vacuum-pressure method may be required for sealing very fine leaks with the styrene-resin mixture," Mr. Blackmun stated in conclusion.

Tuesday Session

At the morning session on Aluminum and Magnesium, April 29, R. T. Wood of the American Magnesium Corp., Cleveland, was the Chairman and Hiram Brown, Solar Aircraft Corp., Des Moines, Co-Chairman.

W. T. Bean, Jr., Continental Aviation & Engineering Corp., Detroit, presented a report on *"The Simplification of Light Metal Casting Design and Its Effect Upon Serviceability."*

Simplification of design, including reduction of number of points of stress concentration, increases fatigue life of castings, Mr. Bean de-

clared. His presentation was profusely illustrated.

"A New Gating Technique For Magnesium Alloy Castings" was described at this meeting by H. E. Elliott and J. G. Mezoff of The Dow Chemical Co., Bay City, Mich. The new method makes possible the introduction of magnesium alloys into molds without flowing large amounts of metal through the lower portion of the casting cavity.

Bottom gating, it was stated, while effective in minimizing pouring turbulence, sets up basically undesirable conditions for the application of controlled directional solidification and thus increases the difficulty of chilling and risering castings to soundness.

Basic features of the new gating system include a slot gate which continually connects the casting with the well and an annular screen, placed concentric with the well within which a quantity of coarse steel wool is loosely packed. The annular screen consists of a cylinder of tinned steel skim gate, commonly used for filtering. The metal enters the mold through the sprue, flows through the runner to the orifice, then drops through the annular screen containing steel wool, whence it flows through the slot gate into the casting cavity.

Controlled Flow

With this gating system, Elliott and Mezoff reported, the flow of metal into the casting cavity is so controlled as to set up favorable thermal conditions for controlled directional solidification. The last metal poured (the hottest metal) comes to rest in the top risers, with little flow of metal through the lower portions of the casting cavity during the filling of the mold. The annular screen serves to filter out any reaction-product skins which may form as the metal drops freely through the orifice down through the well.

The concluding light metals session was a Round Table meeting April 29 at which A. T. Ruppe, Bendix Products Div., Bendix Aviation Corp., South Bend, Ind., presided, assisted by C. E. Nelson, Dow Chemical Co., Midland, Mich. Great interest was shown in the subject, *"Recommended Practices for Aluminum and Magnesium Casting,"* and W. E. Martin, Beryllium Corp., Reading, Pa., acted as discussion leader.

BRASS & BRONZE

Discussion on radiography and segregation in manganese bronze featured the opening technical session of the Brass and Bronze Division in Detroit, April 29. H. M. St. John of Crane Co., Chicago, was Chairman of the meeting and A. K. Higgins of the Allis-Chalmers Mfg. Co., Milwaukee, Co-Chairman.

In a report on *"Radiography of Gun Metal Castings,"* W. H. Baer of the Naval Research Laboratory, Washington, presented data showing that radiographic inspection has practical value in the production of bronze castings, at least for selected castings and pilot castings.

Based on a study of 100 bronze plates, it was shown that defects observed in radiographs are directly related to foundry practice. Characteristic differences were observed in the radiographic studies between gas porosity and distributed shrinkage.

"The radiography of bronze castings has been neglected," declared Mr. Baer, "probably because a large proportion of bronze castings require a pressure test. The pressure test, however, may be very deceiving because it yields no information about the metal below the thin skin of the casting which may be removed by abrasion, corrosion, machining or drilling."

"Segregation in Manganese Bronze," a report of trouble-shooting in the field of manganese bronze was presented at this session by W. W. Edens, Ampco Metal, Inc., Milwaukee, in the absence of the author, George E. Dalbey, metallurgist in the industrial laboratory, Mare Island Naval Shipyard, Vallejo, Cal.

Under some conditions, manganese bronze melts contain a sludge rich in iron, silicon, aluminum and manganese, Mr. Edens said. The studies revealed that formation of the sludge is associated with silicon contents in excess of 0.1 per cent. The amount of sludge formed increases as the silicon content increases and the sludge formation increases as the metal cools from furnace temperature to pouring temperature. Elongation tends to decrease as silicon increases, it was stated, and sludge in the metal will cause thin castings to misrun.

G. P. Halliwell and G. E. Staahl of H. Kramer & Co., Chicago, in a paper on *"Spectrographic Analysis in the Manufacture of Brass and Bronze Ingots,"* pointed out that the spectrograph affords closer control over many elements and savings both in time and operating costs.

Reasons Successful

The success of quantitative analyses may be ascribed to several factors, they stated: strict control over all external conditions affecting the analytical procedure, the use of carefully analyzed standards for each alloy, frequent checks on analytical curves and plate characteristics by the use of standards, and recognition of limitation of the method.

The Annual Round Table luncheon meeting of the Brass and Bronze Division, held April 29, was conducted by B. A. Miller, Baldwin Locomotive Works, Philadelphia, and R. J. Keeley, Ajax Metal Co., Philadelphia, the Co-Chairmen.

(Continued on Page 121)

The Malleable Division held its business meeting during the Annual Convention.

NEW ENGLAND SPONSORS 7TH FOUNDRY CONFERENCE

THE SEVENTH New England Foundry Conference was held at Massachusetts Institute of Technology, Cambridge, March 28-29 with a record attendance over 450. This meeting was sponsored by New England Foundrymen's Association; Massachusetts Institute of Technology; American Foundrymen's Association; Non-Ferrous Founders Society, Boston chapter; Connecticut Foundrymen's Association; and Connecticut Non-Ferrous Foundrymen's Association. Cooperating organizations included AIME, ASME, ASM, AWS and American Industrial Radium & X-ray Society.

The sessions were opened at 9:30 on Friday morning by D. L. Parker, General Electric Co., Lynn, Mass., vice-chairman of the conference. An address of welcome was given by Dean Thomas K. Sherwood, dean of engineering, M.I.T.

Two very interesting and instructive papers occupied the rest of Friday morning's session at which Leroy M. Sherwin, Brown & Sharpe Mfg. Co., Providence, R. I., acted as chairman. Ray Olsen, Production Pattern & Foundry Co., Chicopee, Mass., presented the first paper "Patterns and Related Equipment for Your Foundry." The second concerned "Welding Cast Iron" and was discussed by H. E. Schultz, General Electric Co.

One of the highlights of the conference was the Luman S. Brown Lecture which occurred Friday afternoon. Named in honor of Luman S. Brown, for many years president, Springfield Facing Co., Springfield, Mass., the address was delivered by L. W. Woodhouse, industrial engineer, Bureau of Industrial Hygiene, Connecticut State Department of Health. His subject was "Industrial Hygiene as Applied to the Foundry." Presiding was A.F.A. Past President E. H. Ballard.

Technical sessions were resumed following the lecture and three papers were read. Dr. Walter M. Saunders, Providence, R. I., headed the meeting and he introduced the authors. First paper "Synthetic Core Binders and Their Place in Today's Foundries" was given by H. C. Frisbee, E. F. Houghton & Co. Mechanization was the theme of C. B. Dick's offering as he lectured on "Development Problems in a Mechanized Foundry." Mr. Dick is manager, Feeder Div., Westinghouse Electric Corp., Pittsburgh, Pa. Howard Taylor's "Summary of Latest Developments in the Steel Foundry" closed technical proceedings for the day. Mr. Taylor is associate professor of mechanical metallurgy, M.I.T.

At the conference dinner, held Friday evening in the M.I.T. Graduate House, M. A. Hosmer, Hunt-Spiller Mfg. Corp., Boston, conference chairman, acted as toastmaster. Dr. James R. Killian, vice-president, M.I.T., gave a timely and inspiring talk on some present day educational problems. A.F.A. National President S. V. Wood, Minneapolis Electric Steel Casting Co., Minneapolis, also spoke as did A.F.A. Secretary-Treasurer W. W. Maloney.

The evening's program was concluded with the showing of two sound films.

Returning to the sessions on Saturday morning, A. S. Wright, Hunt-Spiller Mfg. Co., was presiding officer. Tom Barlow, Battelle Memorial Institute, Columbus, Ohio, and N. J. Dunbeck, Eastern Clay Products, Inc., Jackson, Ohio, addressed those in attendance. Mr. Barlow's subject was "Melting and Pouring" while that of Mr. Dunbeck was "A New Chemically Coated Sand for the Foundry."

Following lunch the final meeting was under the guidance of D. F. Sawtelle, Malleable Iron Fittings Co., Branford, Conn. First section of the session was devoted to a round table discussion of non-ferrous problems with S. W. Chappel, Sr., Electric Boat Co., Groton, Conn., acting as discussion leader. The last half of the program was allotted to technical papers. Howard Taylor substituted for S. W. Brinson, Norfolk Navy Yard, Ports-

(Concluded on Page 157)

Some of the members of the New England Foundrymen's Association shown at the Seventh New England Foundry Conference held at Massachusetts Institute of Technology, Cambridge, March 28-29.

(Photos courtesy C. A. Wyatt, Debevoise-Anderson Co.)

NATIONAL

William Waddicor, Jr.
First Prize,
Patternmaking

Increased management interest in the A.F.A. Apprentice Contest featured the 1947 competition. Held annually since 1924, the apprentice contest gives apprentices an opportunity to match their skill at molding or patternmaking against the best on the North American continent. This year management recognized more than ever before that the winners not only receive encouragement through the cash awards and recognition certificates, but also that the quality of apprentice training may be tested in the competition. Some apprentices were entered in the contest for the specific purpose of checking training standards in the sponsoring plant.

The first place winner in the non-ferrous molding division of the 1947 contest, John Hronek of Wisconsin Aluminum Foundry Co., Inc., Manitowoc, placed fifth in the finals in the same division last year. Second and third place in the non-ferrous molding division were awarded to David Gregory, Empire Brass Foundry Ltd., Montreal, and Wilson Bruce, Buckeye Brass & Mfg. Co., Cleveland, respectively.

Winners in the steel molding division were: first, Harold Gobeille and second, John Colombo, both of Crucible Steel Casting Co., Cleveland. This company sponsored the first and second place winners in this division in 1946 also. Walter G. Bach of American Steel Foundries, East Chicago, Ind., took third place.

The first three places in the gray iron molding division were taken by Floyd G. Matthews, Caterpillar Tractor Co., Peoria, Ill., Robert Miller, Hill Acme Co., Cleveland, and Leo Prushinski, Sheffield Foundry Co., Chicago. Caterpillar Tractor Co. also sponsored the first place winner in this division in 1946.

In the patternmaking division of

Floyd G. Matthews
First Prize,
Gray Iron Molding

Harold Gobeille
First Prize,
Steel Molding

John Hronek
First Prize,
Non-Ferrous Molding

Howard J. Rand
Second Prize,
Patternmaking

Leo Prushinski
Third Prize,
Gray Iron Molding

John Colombo
Second Prize,
Steel Molding

Walter G. Bach
Third Prize,
Steel Molding

WINNERS IN APPRENTICE CONTEST

the 1947 contest, the first three places were awarded to William Waddicor, Jr., Brown & Sharpe Mfg. Co., Providence; Howard J. Rand, Aluminum Company of America, Cleveland, and Laurent Messier, Acme Pattern & Woodwork Co., Ltd,. Montreal. Second place winner in 1943, Waddicor was in the armed forces and reentered the competition this year to receive top honors in patternmaking.

The first prize winner in each division attended the 51st Annual Convention and received his certificate and $100 check at the Annual Meeting, Wednesday, April 30. Presentation was by A.F.A. President S. V. Wood, Minneapolis Electric Steel Castings Co., Minneapolis. Other prize winners will receive their awards at chapter meetings or at special plant meetings.

A successful apprentice contest requires the cooperation of a number of men who provide the patterns and blueprints, who judge the patterns and castings, an apprentice contest subcommittee which selects the patterns and blueprint for the competition and, where possible, arranges for x-ray service to enable the judges to make definite decisions regarding casting soundness.

The tracing for the blueprints from which entrants in the patternmaking division made their patterns was provided by E. W. Pierie, Motor Patterns Co., Cleveland, chairman of the Apprentice Contest Subcommittee. The patterns for the molding divisions were supplied by H. K. Swanson, Swanson Pattern & Model Works, East Chicago, Indiana, G. A. Pealer, Elmira Foundry Co., Elmira, N. Y., and J. W. Costello, American Hoist & Derrick Co., St. Paul. One of the gray iron patterns was lost in the mail and replaced through the courtesy of T. H. Ross of the David Ranken, Jr. School of Mechanical Trades, St. Louis.

Local arrangements for judging the 1947 A.F.A. Apprentice Contest were made by two members of the Apprentice Contest Subcommittee, Wayne Stettbacher, secretary, Employers' Association, and P. M. Sanders, consultant, both of Detroit. Judging took place at the Rouge Plant of the Ford Motor Co. through the cooperation of Claude Jeter and Ray Howard; radiographs of the castings, made with a million volt x-ray machine, were provided by Don M. McCutcheon.

Judging of the A.F.A. Apprentice

(Concluded on Page 121)

Laurent Messier
Third Prize,
Patternmaking

Robert J. Miller
Second Prize,
Gray Iron Molding

David Gregory
Second Prize,
Non-Ferrous Molding

Troop Runs Foundry At Scout-O-Rama Exhibit

OVER 20,000 persons viewed the foundry merit badge booth sponsored by the Educational Committee, Northern California chapter at the Scout-O-Rama held in Oakland Auditorium, Oakland, Calif., February 20-22. The operating exhibit attracted a great deal of attention during the three evening and one afternoon sessions as the crowd stood five and six deep watching the Scouts melting aluminum, making molds and pouring their own castings. The A.F.A. publication THE FOUNDRY IS A GOOD PLACE TO WORK was distributed to the fascinated spectators for the purpose of indoctrinating them into the castings industry.

The success of the booth was due to the combined efforts of many A.F.A. Northern California chapter members. Each gave freely of his time and abilities to the Educational Committee chairmaned by A.F.A. National Director S. D. Russell, Phoenix Iron Works, Oakland. Troop 11, Oakland's oldest, guided by Scoutmaster Sam Dodson and assistant Ed Swartz, were given hours of instruction in the art of foundry practice by a number of chapter members.

The castings booth was furnished by various companies and corporations with such necessary equipment as a gas-fired melting furnace, melting pot, blower, jolt squeeze molding machine, flask equipment, pattern and pattern board, safety equipment, skimming rod, bench grinder, molding sand, parting and flux, aluminum ingot, fire boards, tables and benches, riddles and shovels, fire brick, bottom boards, ingot mold and pouring ladle.

The Northern California chapter sponsored project was one of the ten displays of which sound colored movies were taken. There were 87 sponsored exhibits in the auditorium.

Can You Help?

A.F.A. is anxious to obtain some copies of A.F.A. TRANSACTIONS, Volume 52 (1944) from members who may have no use for copies in their files. The supply of this volume is entirely exhausted and a number of important requests have been received for this edition.

For intact copies in good condition A.F.A. will be glad to make arrangements for purchase. If you have a copy of Volume 52 which you do not need, please forward promptly to: The Secretary, American Foundrymen's Ass'n, 222 West Adams Street, Chicago 6, Ill.

Brazilian Founders To Hold Discussion

A.F.A. MEMBERS in Sao Paulo, Brazil, are planning an informal gathering for the discussion of foundry problems, as a result of the discovery by H. A. Hunnicutt, International Nickel Co., Sao Paulo, that 12 members of the Association are located in that city.

Delegate to Congress

Mr. Hunnicutt, who will be remembered as a delegate to the First Western Hemisphere Foundry Congress, sponsored by A.F.A. at Cleveland in 1942, wrote the other members, suggesting a luncheon get-together to provide an opportunity for them to become better acquainted with each other and with their foundry problems.

Members of Troop 11, Oakland, Calif., operating the foundry exhibit which was on display at the Scout-O-Rama held in Oakland Auditorium, February 20-22. The booth was sponsored by the Educational Committee of the A.F.A. Northern California chapter.

(Photos courtesy S. D. Russell, Phoenix Iron Works)

NEW LITERATURE

Arma Corp., 254 36th St., Brooklyn 32, N. Y., introduced its new "Limitron" inspection system in a recent folder. Included is a brief catalog of assemblies, which can be combined to suit requirements of the user.

In Catalog 13-F, South Bend Lathe Works, South Bend 22, Ind., presents complete specifications for its 13-in. precision lathes. Attachments and accessories are also described.

An infra-red appliance designed for flexible, versatile operation in many applications, the "Infra-Tray-Veyor," is described in a new descriptive sheet issued by Miskella Infra-Red Co., East 73rd and Grand Ave., Cleveland 4.

Components and mechanical features of the "Robins Eliptex Screen" are described and illustrated in a new bulletin, No. 111-A, issued by Robins Conveyors, Inc., Passaic, N. J., a division of Hewitt-Robins, Inc. Specific applications in dewatering, heavy-media dewatering and asphalt plants are discussed, and dimensions and clearances of the screen are given.

Latest recommendations on how to use aluminum mill products most effectively will be publicized in the "Technical Advisor," a new monthly technical paper issued by Reynolds Metals Co. "to meet the insistent growing demand for more technical information on fabricating and processing aluminum in all its forms." First issue contains a condensed technical description of the two main processes in the production of aluminum; a question-and-answer section, discussing various problems raised in regard to applications of the metal; and the first article of a series on welding. Address, Technical Editorial Service, 2500 S. Third St., Louisville 1, Ky., to be on the mailing list.

Patternmakers will be interested in the new sixth edition of "The Mahogany Book," issued by the Mahogany Association, Inc., 75 E. Wacker Drive, Chicago 1, and presenting the history of mahogany and its industry, as well as detailing the applications of the wood, long popular in the foundry.

Air motors are the subject of an eight-page bulletin issued by Bellows Senacon Co., Akron 10, Ohio. Applications, control features, specifications and constructional data, are presented, and dimensional drawing included.

Inter-communication systems are described in a new 12-page catalog, issued by Talk-A-Phone Co., Chicago 23. Details of various arrangements, lines and models of the communication units are given, as are operational data and features of the available systems.

"Buckeye Silica Firestone," Bulletin 15-B, issued by Cleveland Quarries Co., Cleveland 15, presents the history, properties and applications of that material in a 22-page, handsomely illustrated booklet. Also included are: technical information, useful reference data and description of the company products.

Sources of information on photo-templates and photolofting, photodials, name and instruction plates, and photogrid printing, are included in a new bibliography of articles and books on industrial photoreproduction, now available from the industrial photographic sales division of Eastman Kodak Co., 343 State St., Rochester 4, N. Y. In another bibliography, on spectrography, the firm offers a 16-page booklet listing articles and books covering the broader aspects of chemical spectrography; equipment and supplies; flash, infra-red and mass spectrography; radiation sources, and "Raman Effect" and ultraviolet spectrography.

In the new "USCO News Casting," U. S. Reduction Co., East Chicago, Ind., offers aluminum foundrymen a monthly digest of news and ideas about aluminum. Published material regarding current developments is abstracted, and editorial discussion on quality control and the function of the laboratory in the foundry, are included in the first issue.

Dow Corning Corp., Midland, Mich., has released revised technical data (Silicone Notes, C 20-2) on DC 2103, thermosetting silicone resin, designed as a heat-stable bonding material for inorganic fabrics in the production of rigid electric laminates, and for the bonding of finely divided particles of mica, silica, carbon or powdered metals.

The complete line of crucible gas-fired furnaces manufactured by Eclipse Fuel Engineering Co., Rockford, Ill., is described in a new three-color bulletin available from the firm. Technical data of interest to foundrymen are included, and the new "RB" and "SB" furnace units are shown.

For the "man in the field," Hose Accessories Co., 2702 N. 17th St., Philadelphia 32, offers a 20-page, pocket size handbook on hose couplings and fittings, designed to provide information through which operating costs can be reduced and the efficiency of equipment increased. Recommendations on care of hose, selection and installation of couplings, and other data are presented in easy-to-read form.

Persson Mfg. Co., 2 Henry St., Bloomfield, N. J., has issued a new bulletin, describing the "Persson Safety Die Jack," designed for fast, simple, safe separation and assembly of die sets.

Instructions for making machinable arc welds in gray iron castings are presented in a new four-page folder issued by C. E. Phillips & Co., 2750 Poplar St., Detroit 8. Recommendations on current settings, arc manipulation and preheating temperatures, are included, as are diagrams illustrating methods of avoiding overheating of castings in typical applications. Metallographic studies and hardness surveys are given in discussions of recommended procedures; and a weld-tempering method for reducing tendency to cross checking in the weld metal is described.

Foundry ladles manufactured by Whiting Corp., Harvey, Ill., are described in a new 44-page catalog issued by the firm. Complete information on ladles for every foundry application is given through photographs, drawings, specification tables and text. Special emphasis is given gear brackets and the new "Pour-Rite" ladles incorporating air-cooled trunnions; ladle handlers and monorail pouring systems are discussed; and unusual pouring problems are considered in a section devoted to special ladles. Ask for Bulletin FY-144.

Performance data on the new "Tennant Revo-Tool" floor machine attachment, a drum-mounted cutter accessory for removing floor soilage, are given in Bulletin 53e, issued by G. H. Tennant Co., 2530 N. Second St., Minneapolis 11. Ten typical heavy industry applications of the Tennant floor machine and the new attachment are detailed in chart form, citing type and depth of floor soilage and the results obtained with the equipment under consideration.

Eye-protective devices for melters, welders, chippers and other workers in the foundry and elsewhere, are described in a new eight-page bulletin, No. CE-29, published by Mine Safety Appliances Co., Braddock, Thomas and Meade Sts., Pittsburgh 8, Pa. Also featured in the bulletin are: the new "Speedframe" goggle mounting, designed to eliminate hand adjustment; "Fogpruf" lense cleaner; and a goggle cleaning cabinet, a convenient, wall-mounted unit to encourage workers to keep their glasses clean and wear them.

Tools, dies and wear resisting parts made from "Malta" cemented carbide and cast "T" and "V" non-ferrous alloys, are shown and discussed in a 24-page catalog published by Jessop Steel Co., Washington, Pa. Complete specifications are given. Requests for the catalog should be made on company letterheads.

Sand blast hose, described as "extra-tough, yet highly flexible," is the subject of a four-page folder now being distributed by Hewitt Rubber, 240 Kensington Ave., Buffalo 5, N. Y., a division of Hewitt-Robins, Inc.

FOUNDRY PERSONALITIES

G. M. Lund was elected president, Despatch Oven Co., Minneapolis, succeeding the late H. L. Grapp, at a recent meeting of the board. Formerly assistant to the president, he has served as comptroller and vice president. Other officers and directors named include **C. P. Doherty,** executive vice president-general manager; **G. L. Schuster,** vice president-treasurer and chief engineer; **Fred Larson,** vice president-secretary and chief electrical engineer; **Ida S. Grapp,** director, and **J. W. Watson,** vice president in charge of the Chicago branch. **A. E. Grapp** continues as chairman of the board.

Duane Vincent has been named president and **Walter Fry,** vice president in charge of production, United Casting Co., Clarkston, Mich., a new subsidiary of United Foundry Co., Detroit.

A. D. Robertson was recently appointed manager of the Tampa, Fla., district office of Allis-Chalmer Mfg. Co., Milwaukee, succeeding the late **Berrien Moore.** Associated with the firm since 1938, Mr. Robertson was recently assistant manager of electrical section sales and engineering, Norwood, Ohio, works. **A. D. Brown,** who has been Los Angeles district office head, will manage the Washington, D.C., office. He replaces **R. N. Landreth,** who will act as assistant to the vice president.

C. G. Purnell has rejoined Carnegie-Illinois Steel Corp., subsidiary of United States Steel Corp., Pittsburgh, as development representative. He will be responsible for expansion of applications of steel in industrial machinery and equipment development work in utilization of natural resources. In his previous association with the firm, Mr. Purnell was a metallurgical contact representative.

Jess Toth, a director and secretary, Harry W. Dietert Co., Detroit, was the recipient of the Detroit Junior Board of Commerce "key man" award in March. **Ray Michaels,** Detroit-Diesel Div., General Motors Corp., Junior Board head, made the presentation. The award was made in recognition of distinguished service in board activities.

C. G. Purnell

Jess Toth

G. M. Lund

J. D. Sullivan

O. L. Allen retired February 1 as foundry superintendent, Pontiac Motor Div., General Motors Corp., Pontiac, Mich. He is succeeded by **D. C. Amburn,** assistant superintendent. **C. E. Silver,** formerly works manager, Michigan Steel Casting Co., Detroit, has moved to the Pontiac firm as assistant superintendent.

Mr. Allen, who began his career with Western Motor Works, Logansport, Ind., in 1903, joined the Pontiac Division in 1939, after an association of 24 years with Wilson Foundry & Machine Co., Pontiac.

S. S. Conway, formerly assistant vice-president, sales department, Brake Shoe & Castings Div., American Brake Shoe Co., Chicago, has been appointed vice-president. **R. L. Robinson,** district sales manager for the division, has been appointed vice-president of the sales department.

W. C. DeRoller, formerly patternmaker, Symington-Gould Corp., Rochester, is now president, DeRoller-Wilshaw Pattern Works, Inc., of that city. He is a member of Rochester A.F.A. chapter.

J. H. Bruhn, formerly supervisor of molding methods for American Steel Foundries, East Chicago, Ind., has been appointed general foundry foreman, Eastern Malleable Iron Co., Wilmington, Del. An A.F.A. member, he will transfer from the Chicago to the Philadelphia chapter.

E. E. Potter has been elected vice president in charge of commercial aspects of customer relations. In that capacity he succeeds **E. O. Shreve,** vice president, who continues as a member of the president's staff on special assignment.

W. B. Peirce, vice president in charge of research, Flannery Bolt Co., Bridgeville, Pa., was elected president, American Society of Tool Engineers, at a recent meeting of the board.

J. J. Nelson will represent the National Bearing Div.; **T. N. Mitchell,** the Kellog Div.; **L. J. Hardwood,** the Electro-Alloys Div., and **G. E. Anne,** the Brake Shoe & Castings Div., American Brake Shoe Co., in the new Philadelphia sales office.

J. D. Sullivan, assistant to the director, Battelle Memorial Institute, Columbus, Ohio, was installed as national president, American Ceramic Society, at the organization's annual meeting, April 23. He served as treasurer in 1944-45 and vice president in 1946.

Graduate of the University of Washington, Seattle, he has been responsible for direction of research in ceramic technology at Battelle since 1931 and has written nearly a hundred papers on ceramics and metallurgy. Mr. Sullivan was a member of the Subcommittee on Cupola Refractories, A.F.A. Cupola Research Project.

J. W. Whittemore, Virginia Polytechnic Institute, Blacksburg, was installed as vice president and **W. E. Cramer,** Industrial Ceramic Products, Inc., Columbus, as treasurer of the society.

F. T. Ward, vice president-chief engineer, Third Avenue Transit Corp., New York, has been elected chairman, mechanical standards committee, American Standards Association. **F. O. Hoagland,** vice president, Pratt and Whitney Div., Niles-Bement-Pond Co., Hartford, Conn., is committee vice chairman.

A. E. Zeisel has been named vice president in charge of sales, Eutectic Welding Alloys Corp. He joined the firm as a field engineer in 1944 and has since been Mid-West regional manager and assistant to the president. **T. H. Leston** has been appointed chief engineer, New York plant.

Harold VonThaden, vice-president, Robins Conveyors Div., Hewitt-Robins, Inc., Passaic, N. J., and a director of the parent firm, has been elected to membership in the Chemical, Metallurgical & Mining Society of South Africa, Johannesburg. He recently visited South Africa on business.

A. W. Lansberg and **J. S. Csaklos** were elected vice presidents, Hartford Electric Steel Corp., Hartford, Conn., at a recent meeting of the board; **T. M. Eckler** was appointed assistant to the president and **R. T. Clarke,** assistant secretary-treasurer. Mr. Lansberg will retain the duties of secretary-treasurer; Mr. Csaklos, those of works manager.

J. S. Csaklos

A. W. Lansberg

L. C. Thellemann for the past year treasurer and director, Kencroft Malleable Co., Inc., Buffalo, has been appointed executive vice president, Steel Founders' Society of America, Cleveland. Associated with the activities of the Western New York chapter for a number of years, Mr. Thellemann is well known by many New York foundrymen. At the 1944 War Production Foundry Congress held in Buffalo, Mr. Thellemann acted as chairman of the publicity committee, as well as an active member of other convention committees. From 1942-46 he was executive secretary of the Inter-Allied Foundries of New York State.

L. C. Thellemann

J. H. Matthews and **O. H. Cilley** were elected vice presidents, and **A. F. Heinsohn,** a director, Rabestos-Manhattan, Inc. at the annual stockholders and directors meetings in New York. Mr. Matthews, since 1942 assistant general manager, Manhattan Rubber Div., Passaic, N. J., will be in charge of the division. Mr. Cilley is assistant general manager, United States Asbestos Div., Manheim, Pa., and Mr. Heinsohn, general manager, General Asbestos and Rubber Div., North Charleston, N. C.

J. H. Staiger has been appointed Chicago representative, alloy division, Michiana Products Corp., Michigan City, Ind. **W. A. Zach** has been named Indiana representative, with headquarters at the Michigan City plant.

C. D. Dallas, since 1931 president, Revere Copper & Brass, Inc., New York, has been elected chairman of the board. **J. J. Russell,** formerly vice president, has been named president.

G. J. Nock, treasurer, The Nock Fire Brick Co., Cleveland, has been named vice president-secretary. He is Secretary, Northeastern Ohio A.F.A. chapter.

W. J. Grede, president, Grede Foundries, Inc., Milwaukee, was recently elected a class B director of the Federal Reserve Bank of Chicago.

R. W. Griswold, Jr. has resigned as vice-president, Griswold Mfg. Co., Erie, Pa., following sale of the firm. Mr. Griswold has not announced his plans for the future. He is a director of Northwestern Pennsylvania A.F.A. chapter.

J. W. Harvey

H. N. Myers

H. N. Myers has joined the central staff of Perfect Circle Corp., Hagerstown, Ind. An A.F.A. member, he was co-chairman of a gray iron session at the 51st Annual Convention in Detroit. He was formerly metallurgist, Sealed Power Corp., Muskegon, Mich.

J. W. Harvey, member of the sales department, Vulcan Mold & Iron Co. Latrobe, Pa., since 1924, has been appointed general sales manager.

H. B. Swan, an A.F.A. member since 1913 and who served as A.F.A. Vice-President, 1915-16, has joined Conover Engineering Co., Cleveland, as foundry consultant, with headquarters in Detroit. Mr. Swan attended the University of Michigan, Ann Arbor. He joined Cadillac Motor Car Div., General Motors Corp., Detroit, in 1911 as a coremaker. Retiring last year after 35 years of service, he was foundry superintendent. He advanced through the ranks by being a coremaker, later a molder's apprentice. He was named assistant superintendent of foundries in 1913 and superintendent, 1919. He helped to build the Cadillac foundries in 1924 and rebuilt them in 1945-46.

E. C. Troy, since 1942 chief metallurgist, Dodge Steel Co., Philadelphia, was recently elected vice president in charge of research and development. He is Vice Chairman of Philadelphia A.F.A. chapter.

E. G. Allen, E. E. Hook, G. R. Sager and **J. C. Eismann** have been elected directors, Dayton Oil Co., Dayton, Ohio. Mr. Hook, company representative at Syracuse, is Chairman, Central New York A.F.A. chapter.

E. W. MacCorkle, Jr., has been appointed Portland district manager, Air Reduction Sales Co., New York. **L. A. Hamilton** has been named manager, Seattle district; and **Herman Van Fleet, Jr.,** manager, New England district.

James MacCaughan, since 1928 production manager, Wilson Foundry & Machine Co., and associated with the firm for 28 years, has been named foundry manager.

Thomas Hargitt has been appointed superintendent, Light Metals Inc., Indianapolis, magnesium casting producers.

Obituaries

Herbert L. Grapp, 52, president, Despatch Oven Co., Minneapolis, died March 22 in California.

He was the son of A. E. Grapp, founder and chairman of the board of Despatch Oven. During the war, Herbert Grapp served as firm manager. He was elected president last year.

Howard M. Fearon, 55, Standard Oil Co. of New Jersey, died March 27 at his home in Madison, N. J.

He had been associated with the engineering division, Esso Sales Department, since 1933. Well known in the petroleum and metal industries and considered an authority on cutting tool lubrication, Mr. Fearon directed development, manufacture and application of new products.

Native of Sayre, Pa., and graduate of Syracuse University, he joined Standard Oil in 1929.

E. L. Berry, 52, vice president in charge of production, Link-Belt Co., Chicago, died April 3.

Associated with the firm since 1914, Mr. Berry was elected vice president in 1944. During the war he was vice president-general manager, Link-Belt Ordnance Co., now dissolved. He was also a director and vice president, Link-Belt Speeder Corp.

W. A. Ross, president, Columbia Steel Co., subsidiary of United States Steel Corp., died April 19 at San Francisco. He was 69.

Native of San Francisco, Mr. Ross spent his entire business career in the steel industry. He was appointed vice president-treasurer, Columbia Steel Co., in 1930, and was elected president in 1939.

John A. Payne, 47, president, Consolidated Coppermines Corp., and chairman of the board, Titan Metal Mfg. Co., Bellefonte, Pa., died April 18.

He headed the Coppermines organization for seven years. Mr. Payne was graduated at Harvard College in 1921.

W. C. Trout, president, Lufkin Foundry & Machine Co., Lufkin, Texas, died April 24 in Dallas.

Mr. Trout, one of East Texas leading industrialists, was a familiar figure in foundry circles, including the A.F.A. Texas chapter. He was president, Texas Foundries, Inc., during its initial operation; was a past vice-president, National Manufacturers Association, a director of that organization for several years; and president, Texas State Manufacturers Association for three years.

Mr. Trout was born in Canada and moved to Milwaukee in 1884. As a designing engineer he was associated with E. P. Allio Co. (later known as Allis-Chalmers Mfg. Co.). In 1893 accepted a position with Allis-Chalmers Mfg. Co. as draftsman, saw mill department. Became a contracting engineer (1900) for the above concern, designing and selling lumber plants. He settled in Lufkin, Texas, in 1905 when he bought a substantial interest in the Lufkin Foundry & Machine Co.

★ NEW A. F. A. MEMBERS ★

March 15 to April 15—Chapter number 36, Tri-State, ran off with top honors this month by annexing 31 new members, including one company membership. Detroit bunched 26 together for second highest total and Chicago 16, including one company member, took third position. Eighteen company memberships are shown on these pages, and thirty-three chapters contributed to this membership list of 271. Twelve foreign lands are represented which is indicative of the interest in American foundry practices and methods.

BIRMINGHAM DISTRICT CHAPTER

***Anderson Brass Works, Inc., Birmingham. (R. L. Lock, Vice-Pres.)**
***Maddox Foundry & Machine Works, Inc., Archer, Fla.**
Fred C. Barbour, Chief Chemist, McKane Cast Iron Pipe Co., Birmingham.
J. J. Lally, Supt., Caldwell Foundry & Machine Co., Birmingham.
C. D. Maddox, Sec'y.-Treas., Maddox Foundry & Machine Works, Inc., Archer, Fla.
H. Maddox, President, Maddox Foundry & Machine Works, Inc., Archer, Fla.
W. D. McIlvaine, Prof. of Met., University of Alabama, University.
Robert B. Oliver, Prof. of Met., University of Alabama, University.
James R. Reynolds, Equipment Engr., The Hill & Griffith Co., Birmingham.
Frank M. Robbins, Jr., Robbins & Bahr, Chattanooga, Tenn.
Richard M. Schmidt, Inspector, American Cast Iron Pipe Co., Birmingham.
H. S. Williams, Partner, J. H. Zehmer Co., Inc., Birmingham.

CANTON OHIO CHAPTER

Edwin D. Lucas, Field Met., Niagara Falls Smelting & Refining Div., Continental United Industries Co., Inc., Buffalo, N.Y.
Harry Craig White, Asst. Plt. Supt. & Chf. Met., United Engineering & Foundry Co., Canton.
Michael Wolf, Brass Fdry. Supvr., Pitcairn Co., Barberton.
Thomas F. Wright, Off. Mgr., Exothermic Alloys Sales & Service, Inc., Massillon.

CENTRAL INDIANA CHAPTER

***Pope Foundry & Machine Co., Inc., Marion. (G. Robt. Clark, Asst. Treas.)**
***Roots-Connersville Blower Corp., Connersville. (Ralph R. Newquist, V.P.)**
Arlie E. Caudle, Appl. Engr. Roots-Connersville Blower Corp., Connersville.
R. L. Conley, Gang Frm., Louisville & Nashville R. R., Louisville, Ky.
J. W. Dunn, Fact. Mgr., Rockwood Mfg. Co. Indianapolis.
Marion E. Loudenback, Fdry. Supt., Frank Foundies Corp., Muncie.
Charles Myers, Fdry. Frm., Rockwood Mfg. Co., Indianapolis.
Walter E. Palmer, Supt., Rockwood Mfg. Co., Indianapolis.
E. O. Spahr, National Malleable & Steel Castings Co., Indianapolis.
Geo. J. Sutton, Asst. Fdry. Frm., Rockwood Mfg. Co., Indianapolis.

CENTRAL NEW YORK CHAPTER

Robert William Cologgi, Fdry. Engr., Goulds Pumps, Inc., Seneca Falls.
Floyd F. Lendrum, Frm., New York Air Brake, Watertown.
Angelo Joseph Marotta, Chf. Met., Utica Radiator Corp., Utica.
N. W. Meloon, Jr., Pres., Meloon Bronze Foundry, Inc., Syracuse.
Clyde R. Swartz, Owner, Binghamton-Pattern Works, Binghamton.

CENTRAL OHIO CHAPTER

***Summer & Co., Columbus. (T. W. Payne, Asst. Vice-Pres.)**
Carl Klaffke, Asst. Gen. Mgr. of Foundries, Lennox Furnace Co., Columbus.
W. Harold Marshall, Supt., The American Steel Abrasives Co., Galion.
Joseph B. Myers, Southeastern Sales Co., Springfield.
Geo. S. Stettenfeld, Staffman Furnace Foundry Co., Jackson.
Joseph S. Summer, V.-P., Summer & Co., Columbus.

CHESAPEAKE CHAPTER

James O'Keeffe, Jr., Walker Machine & Foundry Corp., Roanoke, Virginia.
W. Elbert Sexton, President, S. B. Sexton Foundry & Mfg. Corp., Baltimore, Md.

CHICAGO CHAPTER

***Carb-Rite Co., Chicago Heights. (J. O. Griggs, President)**
J. J. Brown, Salesman, Edw. S. Christiansen Co., Chicago.
John P. Cornelison, Payroll, McCarthy Foundry Co., Chicago.
George P. Halliwell, Dir. of Res., H. Kramer & Co., Chicago.
Robert H. Hoffman, Pres., Robt. W. Hoffman Co., Inc., Chicago.
Lawrence C. Huff, Sec'y., McCarthy Foundry Co., Chicago.
John R. Jenkins, Res. Met., American Steel Foundries, East Chicago, Ind.
Daniel A. Johann, Dist., Mgr., Roots-Connersville Blower Corp., Chicago.
Marvin A. Kellermann, Owner, Kellermann Pattern & Foundry, Chicago.
Henry Frank Linkowski, Melter, International Harvester Co., Chicago.
William F. McCarthy, Jr., Met., McCarthy Foundry Co., Chicago,
L. W. McConnell, V.-P., Carb-Rite Co., Chicago Heights.
George E. Mueller, Treas., McCarthy Foundry Co., Chicago.
Charles M Uline, Sec'y.-Treas., Carb-Rite Co., Chicago Heights.
Charles B. Willmore, Chf. Met., Wm. F. Jobbins, Inc., Aurora, Ill.
Theodore B. Wrobel, Frm., McCarthy Foundry Co., Chicago.

CINCINNATI DISTRICT CHAPTER

John C. Medford, Patt. & Fdry. Engr., Chrysler Corp. Airtemp Div., Dayton, Ohio.

DETROIT CHAPTER

Nicholas S. Aagesen, Salesman, Semet-Solvay Co., Detroit.
Earl R. Baisley, Frm., Metal Pattern Shop, Kelsey-Hayes Wheel Co., Detroit.
William H. Breech, Slsm., Peninsular Grinding Wheel Co., Detroit.
Collins L. Carter, Pres. & Gen. Mgr., Albion Malleable Iron Co., Albion, Mich.
Charles Dean Chamberlin, Sls. Engr., Claude B. Schneible Co., Detroit.
Erwin R. Cprek, Met. Tester, Ford Motor Co., Dearborn, Mich.
Fred N. Eaton, Plant Mgr., Aluminum Sand Foundry, Bohn Aluminum & Brass Corp., Detroit.
Ralph Fox, Frm., Federal Mogul Corp., Detroit.
Robert Hardy, Asst. Fdry. Supt., Kelsey-Hayes Wheel Co., Detroit.
Clarence H. Hauser, Fdry, Supt., Wayne Foundry Co., Detroit.
Robert C. Larsen, Abrasive Engr., Peninsular Grinding Wheel Co., Detroit.
Paul Guy Maganus, Fdry, Mgr., Warren Alloy & Machine Co., Warren, Mich.
James J. Miller, Gen. Frm., Kelsey-Hayes Wheel Co., Detroit.
Willard R. Morron, Sls. Engr., Peninsular Grinding Wheel Co., Detroit.
Walter B. Pierce, Instructor, University of Michigan, Ann Arbor.
M. S. Riaz, Automotive Engr., East Lansing, Mich.
John Schneider, Asst. Supt., Ford Motor Co., Dearborn.
George Charles Schreiber, Sales-Engr., Claude B. Schneible, Detroit.
John Sulga, Fdry. Supt., Kelsey-Hayes Wheel Co., Detroit.
Harry B. Swan, Fdry. Consultant, Detroit.
Robert E. Tallman, Process & Production Engr., Pontiac Motor Car Div., Pontiac, Mich.
George E. Westerholm, Mgr. Feld Engrg., Peninsula Grinding Wheel Co.
Horace Weston, Gen. Frm., Packard Motor Car Co., Detroit.
J. E. Whalen, Sls. Engr., E. J. Woodison Co., Detroit.
A. S Wyborski, Abrasive Engr, Peninsula Grinding Wheel Co., Detroit.

E. CANADA & NEWFOUNDLAND CHAPTER

Henri Bourassa, Prof. en Modelerie, Ecole Tech. des Trois-Rivieres, Trois-Rivieres, Que.
Marcel G. Desgent, Time Study, Crane, Ltd., Montreal Que.
Leon Gadoury, Asst. Frm., Brass Fdry., Crane Ltd., Montreal, Que.
Philippe Gendron, Coremaker, Crane, Ltd., Montreal, Que.
Leon Lesage, Prof. en Fonderie, Ecole Tech. des Trois-Rivieres, Trois-Rivieres, Que.
Jean Matte, Engrg. & Design Dept., Sorel Industries, Ltd., Sorel, Que.
Roger Sequin, Clerk, Standards Dept., Crane, Ltd., Montreal, Que.
John D. Walker, Supt., Crane, Ltd., Montreal, Que.

METROPOLITAN CHAPTER

Leonard J. Edel, Engr., Fdry. Sls. Div., Link-Belt Co., Philadelphia.
Everett G. Gentry, Core Oil-Salesman, Penola Inc., Chicago.
William T. Maher, Met., Barnett Foundry Machine Co., Irvington, N. J.
Ernest R. Miller, Fdry. Supt., Bethlehem Steel Co., Staten Island, N. Y.
Donald E. Whitehead, Partner, Whitehead, Sanger & Hoidge, New York.
Henry G. Wickham, V.-P., Wickham Piano Plate Co., Springfield, Ohio.

MEXICO CITY CHAPTER

David E. Stine, Gen. Fdry. Supt., La Consolidada, S. A., Mexico.

* Company Member

MICHIANA CHAPTER

*Central Pattern, Inc., Elkhart, Ind. (Fred W. Manthey, President)
Chester Dukes, Gen. Frm., Flint & Walling Mfg. Co., Inc., Kendallville, Ind.
Orrin F. Hiler, Supt., Chas. O. Hiler & Son, Walkerton, Ind.
George V. Pettit, Grinding Room Frm., Elkhart Brass Mfg. Co., Elkhart.
B. J. Strassle, Gen. Frm., Peru Foundry Co., Peru, Ind.
George T. Taylor, Abrasive Engr., Norton Co., Worcester, Mass.
R. W. Wolfram, Plant Engr., Benton Harbor Malleable Industries, Benton Harbor, Mich.

NORTHEASTERN OHIO CHAPTER

Harry C. Ahl, Jr., Met. Engr., Ohio Brass Co., Mansfield.
R. L. Collier, Exec. V.-P., Gray Iron Founders' Society, Inc., Cleveland.
Howard J. Dennis, Sales Engr., Mullite Refractories Co., Shelton, Conn.
T. L. Godden, Dist. Mgr., Thiem Products Co., Milwaukee.
Robert E. Keith, Met., Light Metals, Thompson Products, Inc., Cleveland.
Charles G. Murphy, Fdry. Engr., National Tube Co., Lorain, Ohio.
Chas. J. Nock, Gen. Mgr., Nock & Son Co., Cleveland.
Thomas Russell, Frm., Pattern Shop, The Osborn Mfg. Co., Cleveland.
Benjamin A. Smith, V.-P., Secy-Dir. of Engrg., C. O. Bartlett & Snow Co., Cleveland.

NORTHERN CALIFORNIA CHAPTER

*Belmont Foundry, Inc., Belmont. (E. L. Bloomster, V.-P., Gen. Mgr.)
*Globe Metals Co., Oakland. (B F McDonald, Partner)
*Waterman Foundry Co., Exeter. (Don Waterman, Partner)
John Bermingham, E. F. Houghton & Co., LaFayette.
Victor S. Hoaster, Supt., Belmont Foundry, Inc., Belmont.
J. D. Ramaley, Salesman, The Aluminum Co. of America, San Francisco.
O. R. Showalter, Partner, Waterman Foundry Co., Exeter.
Leo M. Shriver, Supt., Waterman Foundry Co., Exeter.
Herrick Waterman, Partner, Waterman Foundry Co., Exeter.

NORTHWESTERN PENNSYLVANIA CHAPTER

*Erie Forge Co., Erie. (R. W. Devine, Fdry. Supt.)
Merton C. Cooper, Pres., Westside Foundries, Erie.
J. P. Devine, Asst. Supt., Erie Forge Co., Erie.
R. A. Dugan, Frm, Erie Forge Co., Erie.
E L. Hodge, Mgr., Casting Sales, Erie Forge Co., Erie.
J. J. White, Jr., Met., Erie Forge Co., Erie.
Allyn S Wright, V.-P., Reed Mfg. Co., Erie

ONTARIO CHAPTER

Paul Bruder, Owner-Mgr., Paul Bruder Foundry, Kitchener.
R. H. Butler, Fdry. Engr., Canadian Foundry Supplies & Equip., Toronto.
W. A. Farnell, Beatty Bros. Ltd., London.
Albert C. Kurt, Melverton.
D. Macbeth, Frankel Bros. Ltd., Toronto.
Walter J. Price, Supt., Lakeside Foundry, Port Colborne.
J. E. Rehder, Met. Engr., Bureau of Mines, Dept. Mines & Resources, Ottawa.

OREGON CHAPTER

E. T. Barnett, Secy.-Treas., Vocational Industries Corp., Salem.
Geo. R. Bogue, Mgr., Abrasive Dept., General Tool Co., Portland.
Norman R. Ekholm, Abrasive Engineer, Norton Co., Worcester, Mass.
R. V. Grafton, Patternmaker, Peerless Pattern Works, Portland.

PHILADELPHIA CHAPTER

*Keystone Grey-Iron Foundry Co., Pottstown, Pa.
Leonard E. Bilger, Pres., Keystone-Grey Iron Foundry Co., Pottstown, Pa.
Norman Burr, Met., U. S. Pipe & Foundry Co., Burlington, N. J.
Emil M. Butwell, Time Study & Methods Supvr., Olney Foundry Div., Link-Belt Co., Philadelphia.
W. D. Haentjens, Design Engr., Barrett, Haentjens & Co., Hazleton, Pa.
Howard J. Price, Supt. Keystone Grey-Iron Foundry Co., Pottstown, Pa.
F. William Van Ness, Supt., Spec. Prod. Div., U. S. Pipe Foundry Co., Burlington, N. J.

QUAD CITY CHAPTER

Samuel Edelman, Inspector, Riverside Foundry-S. & W. Corp., Bettendorf, Iowa.
Geo. Ver Beke, Gen. Frm., Union Malleable Iron Works, Deere & Co., East Moline, Ill.

ROCHESTER CHAPTER

G. Arthur Spindler, City Pattern Works, Rochester, N. Y.

ROCKY MOUNTAIN EMPIRE CHAPTER

Jerome F. Angell, Owner, Empire Foundry Co., Denver.
Rollin H. Haskett, Molder, Colorado Brass Foundry Co., Denver.
Walter P. Rolf, Foreman, Empire Foundry Co., Denver.
Albert J. Turner, Furnace Operator, Colorado Brass Foundry Co., Denver.

* Company Member

SAGINAW VALLEY CHAPTER

Arthur Herryman, Foreman, Chevrolet Grey Iron Foundry, General Motors Corp., Saginaw, Mich.
Theodore V. Lindbury, Student, General Motors Institute, Flint, Mich.
William K. Middleton, Time Checker, General Foundry & Mfg. Co., Flint.
Peder E. Moluf, Engr., Dow Chemical Co., Bay City, Mich.
Edward O'Brien, Gen. Fdry. Frm., Baker Perkins, Inc., Saginaw, Mich .
Paul W. Olson, Asst. Personnel Dir., Eaton Mfg. Co., Fdry. Div., Vassar, Mich.
Karl F. Otto, Jr. Met., Central Foundry Div., General Motors Corp., Saginaw Malleable Iron Plant, Saginaw, Mich.
Otto C. Stoffel, Co-Owner, Mercury Pattern Works, Saginaw, Mich.

ST. LOUIS DISTRICT CHAPTER

H. M. Aitkenhead, Salesman, American Car & Fdry., St. Louis.
Howard P. Burgess, Partner, Acme Pattern Co., Belleville, Ill.
George A. Fisher, Jr., Mgr., St. Louis Technical Section, Dev. & Research Div., International Nickel Co., Inc., St. Louis.
Clifford M. Jennewein, Salesman, Corn Products Sales Co., St. Louis.
James P. Kennedy, Sales Engr., Sterling Grinding Wheel Div., Tiffin, Ohio.
H. John King, Partner, K R S Bronze Foundry, St. Louis.
Frank W. Ladwig, St. Louis Steel Casting Co., St. Louis.
Lou G. Masner, Sales & Engrg., Joseph Dixon Crucible Co., Jersey City, N. J.
Cleo E. Mikel, Salesman, Corn Products Sales Co., St. Louis.
G. L. Mitsch, Asst. Plant Engr., American Car & Foundry Co., St. Louis.
W. E. Sheppard, Service Engr., Swan Finch Oil Corp., Chicago.
H. Ben Wessel, Secy., M. W. Warren Coke Co., St. Louis.

SOUTHERN CALIFORNIA CHAPTER

George K. Dreher, Plant Mgr., Olds Alloys Co., Southgate.
M. H. Kunzman, Fdry. Frm., General Electric Co , Ontario Works, Ontario.
R. S. Maynard, Fdry. Prod. Control, Apex Steel Corp., Ltd., Los Angeles.

TEXAS CHAPTER

Edwin P. Clarke, Dist. Rep., American Wheelabrator & Equipment Corp., Mishawaka, Ind.

TOLEDO CHAPTER

John L. Austin, Salesman, Robinson Clay Products Co., Akron, Ohio.

TRI-STATE CHAPTER

*Service Foundry Inc., Wichita, Kan. (F. R. Westwood, Sr., Owner.)
C. C. Beagle, Fdry. Supt., The Webb Corp., Webb City, Mo.
C. O. Beckett, Secy., Progressive Brass Mfg. Co., Tulsa, Okla.
C. H. Bentley, Pres., The Webb Corp., Webb City, Mo.
Clyde B. Fisher, Plt. Engr., Enardo Mfg. Co., Tulsa, Okla.
Jack M. Foster, Salesman, Leland Equipment Co., Tulsa, Okla.
George Fowler, Core Room Frm., Acme Foundry & Machine Co., Coffeyville, Kan.
Lyle K. Fulton, Fdry. Supt., Acme Foundry & Machine Co., Blackwell, Okla.
R. E. Gilmore, Owner, Gilmore Pattern Works, Tulsa, Okla.
H. T. Gudgen, Pattern Supt., Acme Foundry & Machine Co., Coffeyville.
David Wm. Harris, Supt., G. I. Foundry, Frank Wheatley Pump & Valve Mfr., Tulsa, Okla.
Will Harris, Supt., Tulsa Iron Works Co., Tulsa, Okla.
H. T. Hendricks, Fdry. Supt., McNally Pittsburgh Foundries, Inc., Pittsburgh, Kan.
Frank Hickman, Pres., Enterprise Foundry, Inc., Oklahoma City, Okla.
L. J. Hockett, Supt. of Iron Fdry., Service Foundry, Inc., Wichita, Kan.
O. S. Hubbard, Owner, O. S. Hubbard Co., Tulsa, Okla.
Kenneth Lee Kimball, Asst. Mgr., Thompson Hayward Chemical Co., Tulsa, Okla.
J. Ollie Lee, Fdry. Supt., Muskogee Iron Works, Muskogee, Okla.
Frank G. Lister, Sales Repr., Chicago Pneumatic Tool Co., Tulsa, Okla.
S. B. Livingston, Owner, Pattern & Model Works, Tulsa, Okla.
Leo J. Masching, Brass Foundry Supt., Frank Wheatley Pump & Valve Mfr., Tulsa, Okla.
Dan A. Mitchell, Salesman, Progressive Brass Mfg. Co., Tulsa, Okla.
Les C. Parrish, Supt., El Dorado Foundry Inc., El Dorado, Kan.
N. G. Reed, Fdry. Frm., Acme Foundry & Machine Co., Coffeyville, Kan.
Jack E. Satterlee, Pres., El Dorado Foundry, Inc., El Dorado, Kan.
A. C. Skelton, Patt. Shop Frm., Acme Foundry & Machine Co., Blackwell, Okla.
Loren C. Steel, Asst. Secy-Treas., Union Machine Co., Bartlesville, Okla.
Frank R. Westwood, Jr., Brass Foundry Frm., Service Foundry, Inc., Wichita, Kan.
J. E. Winger, Secy-Treas., Tulsa Iron Works Co., Tulsa, Okla.
J. G. Winget, Foundry Supt., Reda Pump Co., Bartlesville, Okla.
Joe Woodin, Fdry. Supt., Progressive Brass Mfg. Co., Tulsa, Okla.

TWIN CITY CHAPTER

Albert A. Heinrich, Fdry. Frm., Minneapolis Moline Power Implement Co., Minneapolis.
Elmer W. Johnson, Frm., Minneapolis Moline Power Implement Co., Hopkins, Minn.
Adam Roehl, Fdry. Frm., Minneapolis Moline Power Implement Co., Minneapolis.
Olaf H. Skoglund, Core Room Frm., Minneapolis Moline Power Implement Co., Hopkins, Minn.
W. Donald Todish, Fdry. Supt., Perfection Mfg. Corp., Minneapolis.

WASHINGTON CHAPTER

***Morel Foundry Corp., Seattle. (Leon Morel, Jr., Secy.)**
***Skagit Steel & Iron Works, Sedro-Woolley, Wash. (S. S. McIntyre, Pres. & Gen. Mgr.)**
Leo Becraft, Fdry. Frm., Skagit Steel & Iron Works, Sedro-Woolley.
Edward C. Gustin, Western Foundry Sand Co., Seattle.
J. F. Hebert, Fdry. Supt., Skagit Steel & Iron Works, Sedro-Woolley.
Frank H. Jefferson, Salesman, Carl F. Miller Co., Seattle.
August R. Sandberg, Fdry. Frm., Morel Foundry Corp., Seattle.

WESTERN MICHIGAN CHAPTER

Stewart J. Bell, Abr. Engr., Norton Co., Worcester, Mass.
Frederick Boerkoel, Salesman, Wolverine Foundry Supply Co., Detroit.
Max Borgeson, Sales Dept., Lakey Foundry & Machine Co., Muskegon.
Clayton C. Kaiser, Abr. Engr., Norton Co., Worcester, Mass.

WESTERN NEW YORK CHAPTER

***New York Car Wheel Co., Buffalo. (Max Ryen, Plant Eng.)**
John Archer, Controlman, Pohlman Foundry Co., Buffalo.
Harry A. Koegler, Sales Repr., General Refractories Co., Buffalo.
Warren L. Pell, Owner, Bison Industrial Supply, Buffalo.

WISCONSIN CHAPTER

Edwin D. Baugh, Student Met. Engr., University of Wisconsin, Madison.
L. J. DuBrucq, Sales, Chas. A. Krause Milling Co., Milwaukee.
R. J. Kelly, Buyer, Twin Disc Clutch Co., Racine.
Julius J. Kripke, Owner, Kripke Bag & Wiper Co., Milwaukee.
Leo J. Kudlak, Frm., Maynard Electric Steel Castings Co., Milwaukee.
Walter Puzach, Fdry. Insp., Milwaukee Gas Specialty Co., Milwaukee.
D. P. Schmidt, Met. Engr., (Student) University of Wisconsin, Madison.
R. C. Whittington, Sales, Chas. A. Krause Milling Co., Milwaukee.

OUTSIDE OF CHAPTER

***Engineering Castings, Inc., Marshall, Mich. (Albert E. Rhoads, Pres.)**
State Geological Survey, Urbana, Ill.
Warren Van N. Baker, Auburn, Mass.
David W. Boyd, Fdry. Mgr., Engineering Castings, Inc., Marshall, Mich.
Kenneth Loer, Supt., Engineering Castings, Inc., Marshall, Mich.
David E. Sherman, Purch. Agt., Engineering Castings, Inc. ,Marshall, Mich.
Frank Elsner, Pres., Elsner-Fitz Foundry, Inc., Hanover, Penna.
Ralph L. Smith, Pres., Watsontown Foundry Co., Inc., Watsontown, Pa.
Industrial Arts Dept., Oregon State College, Corvallis, Ore.
G. H. Frith-Smith, Slsm., Smith Sheet Metal Works, Ltd., Vancouver, B. C.
L. K. Frith-Smith, Supt., Smith Sheet Metal Works, Ltd., Vancouver, B. C.

ARGENTINA

Guillermo Uriburu, Plant Engr., "Moldifer" S. R. L., Capital Federal.

AUSTRALIA

L. Benini, Footsoray, Victoria.
George Hallenstein, Gatic Castings Pty. Ltd., Brunswick, Victoria.
W. H. Rapp, International Harvester Co. of Australia Pty. Ltd., Geelong, Victoria.

BELGIUM

S. A. John Cockerill, Secretariat General, Seraing.
Fernand Frenay, Dir., Societe John Cockerill, Seraing.
Emile Henricot, S. A. Usines, Court-St. Etienne (Brabant).

BRAZIL

Dante Bruno Papaleo, Porto Alegro, Rio Grande do Sul.
Silvia de Lima Vaz, Librarian, Institute de Pesquisas Tecnologicas, Sao Paulo.

FRANCE

***Fonderie des Ardennes, Pont Audemer (Eure). (L. Daugenet, Gen. Dir.)**
Pierre Daugenet, Dir. Tech. de Fonderie, Fonderie des Ardennes, Pont Audemer (Eure).
L'Union Europeene Industrielle & Financiere, Paris.

HUNGARY

Weisz Manfred, Adel-Es Femmuvie Rt., Budapest.

INDIA

Mukand Iron & Steel Works, Ltd., Badamibagh, Lahore.
The Director (Co-Ordination), Office of Director-General, Industries & Supplies, Government of India, New Delhi.

SCOTLAND

Albert Eyden, Renfrew Foundries, Ltd., Hillington, Glasgow.

SOUTH AFRICA

H. Pillman, Crown Mines, Brown Industrial Township, Johannesburg.

SPAIN

Manuel Junoy Cornet, Ind. Engr., LaMaquinista Terrestre y Maritima, Barcelona.

SWEDEN

A/B Finnboda Varf, Stockholm.
Scania-Vabis A/B, Sodertalje.

URUGUAY

Talleres Metalurgicos el Acero, S. A., Montevideo.

* Company Member

FUTURE CONVENTIONS AND EXHIBITS

American Iron and Steel Institute, New York—May 21-22.

American Society of Mechanical Engineers, Aviation Meeting, Los Angeles—May 26-29.

Association of Iron and Steel Engineers, Spring Conference, Philadelphia—May 26-27.

American Society of Mechanical Engineers, Oil and Gas Power, 19th National Conference, Cleveland—May 21-24.

Electric Metal Makers Guild, Inc., Fifteenth Annual Meeting, Hotel Roosevelt, Pittsburgh, Pa.—June 5-7.

American Coke and Chemical Institute, French Lick, Ind.—June 9-11.

Milan International Fair, Milan, Italy—June 14-29.

American Society of Mechanical Engineers, Semi-Annual Meeting, Chicago—June 15-19.

American Society for Testing Engineers, Applied Mechanics Division, Schenectady, N. Y.—June 23-25.

American Standards Association, Seminar on Industrial Standardization, Engineering Societies Building, New York—June 23-27.

Railway Supply Manufacturers' Convention, Atlantic City, N. J.—June 23-28.

AMERICAN FOUNDRYMEN'S ASSOCIATION, CHAPTER CHAIRMAN CONFERENCE—July 7-9.

FIRM FACTS

National Carbon Co., a unit of **Union Carbide & Carbon Corp.,** New York, has opened a new modern plant for the manufacture of flashlight cases, at St. Albans, Vt. Plant property embraces 56 acres of landscaped grounds, highway frontage of 1,750 feet and four buildings: the main manufacturing building, one story in height and providing 80,000 square feet of floor space; a one-story office building; a boiler house; a garage, and an oil and solvent storage structure.

Standard Horse Nail Corp., New Brighton, Pa., celebrating its 75th anniversary this year, was the subject of a news write-up in a recent issue of The News-Tribune, New Brighton. History of the firm, which manufactures foundry chill nails, horse shoe nails, keys and pins, was traced from its founding in 1872, and officers and longtime employees of the organization were listed. The firm's operations, products, and history were reviewed in a two-page advertisement.

Wheelco Instruments Co., Chicago, has completed arrangements with **Ether, Ltd.,** Birmingham, England, whereby the English firm will manufacture Wheelco instruments and market them in the United Kingdom. All Wheelco English patents and rights have been transferred to the Ether firm. The instruments will be sold under "Ether-Wheelco Controls."

Harry W. Dietert Co., Detroit, organized in 1925 by Harry W. Dietert, has been incorporated in the state of Michigan. Officers are H. W. Dietert, president; A. D. Dietert, vice-president; Jess Toth, secretary, and Douglas Buss, treasurer. Research and manufacturing facilities of the firm are to be expanded. The company has available for distribution to the foundry industry a number of motion pictures on foundry topics: "Hot Strength Test of Molding Materials," one 300-foot reel, color; "Heat Shock Tests on Cores," one 400-foot reel, color; "A Study of Rat Tail Casting Defect," time, 15 minutes; "The Rate of Core Collapsibility . . . Core Knock-out as Measured by Retained Strength," one 250-foot reel, color; "Mold Atmosphere," 300-foot reel, color, and "Mold Atmosphere—Part 2," 300-foot reel, color. All are on 16-mm. film.

Detroit Testing Laboratory, Detroit, announces that Dr. Charles Lipson, formerly head of the stress analysis laboratory, **Chrysler Corp.,** Detroit, has joined the laboratory organization as consulting engineer and an associate. He will be principally concerned with the strength and performance of parts and assemblies in the development of new designs and processes, modification of designs and processes, and determination of causes and remedies for failures.

Mass production of gray and white iron, semi-steel and non-ferrous castings, will be undertaken by **Associated Mfg. & Foundry Co., N.S.L.,** recently incorporated at Albuquerque, N. M., with authorized capital stock of 500,000 dollars. Manufacture of agricultural implements, farm machinery, gates and valves for irrigation, soil pipe, plumbing fixtures, welding rod also will be included in the firm operations. Stockholders elected G. H. Wood, William Klein, Sr., G. H. Atkinson, C. D. Gibson, and Dr. J. W. Schroer as directors. The company plans to construct a modern plant incorporating overhead sand conditioning, continuous pouring, automatic shake-out and shot-blast equipment.

Adelsman Foundry, Fergus Falls, Minn., is in production at a new and modern foundry plant, which replaces the old facilities, destroyed by fire.

United Engineering & Foundry Co., Pittsburgh, Pa., has completed a steel casting weighing 472,000 pounds, believed to be the world's largest. Cast at the firm's plant in New Castle, Pa., for **Ajax Mfg. Co.,** Cleveland, the casting forms a frame for a 6000-ton capacity forging press.

Adolph I. Buchler, Chicago, has been appointed agent in the United States and Canada for the Swiss-made **Amsler** testing equipment. Distribution in Canada will be through Sheppard Electrical Laboratories, Ottawa, Ont.

Reliable Pattern & Castings Co., Cincinnati, announces a change in corporate name to **Reliable Castings Corp.** The change was made to stress the major products of the firm: brass, bronze and aluminum castings, since the pattern business represents only a small percentage of operations carried on by the firm.

General Foundries Co., Milwaukee, has purchased a substantial portion of the properties of **Leathem D. Smith Shipbuilding Co.,** Sturgeon Bay, Wis., and will establish the No. 2 plant there.

Highland Foundry Co., Blanchester, Ohio, has been purchased by V. E. Bernard and H. C. Garinger, associated with **Wilmington Castings Co.,** Wilmington, Ohio. Production of gray iron castings will be continued under the new ownership.

Gunite Foundries Corp., Rockford, Ill., has purchased from the War Assets Administration a double foundry building adjoining the Gunite plant, and operated since the war on an interim lease by the firm. The facilities have been converted for the production of finished steel truck wheels.

National Lead Co., New York, has extended its retirement annuity and life insurance plan to employees of its subsidiary, **Canadian Titanium Pigments, Ltd.,** Montreal. The program also provides for visiting nurse care. Pamphlets on accident prevention and health conservation are furnished.

International Nickel Co., New York, has expanded its program of cooperation with educational engineering institutions and has made available to a number of such units material for classroom instruction, including an exhibit comprising 50 specimens of materials in which nickel is used; a portable metals identification kit of some 35 specimens of important metals and alloys for qualitative analysis, and literature and other technical and practical information concerning nickel. Motion pictures of mining, smelting and refining operations also will be made available. The program is an activity of the firm's development and research division, and is under the direction of Dr. W. A. Mudge.

A two-story concrete and masonry warehouse building, 80 x 58 feet, has been added to the facilities of **Frederic B. Stevens, Inc.,** Detroit.

Research fellowships for advanced study in scientific and industrial fields have been awarded by the General Electric Educational fund for 14 graduate students, **General Electric Co.,** Schenectady, N. Y., has announced.

Vassar Electroloy Products, Inc., Vassar, Mich., recently tripled its capacity with the addition of new equipment, President K. H. Priestly announced. Organized less than a year ago, the firm produces valve seat and other high alloy, heat and corrosion resistant castings.

The history and products of **Electro Refractories & Alloys Corp.,** Buffalo, N. Y., were reviewed in the Buffalo Evening News of January 2 by G. S. Diamond, president of the firm. The issue carried the paper's "Frontier Industrial Leaders" feature.

Fire-Fyter Products Co., 5216 W. North Ave., Chicago, has been named exclusive distributor in northeastern Illinois of the extinguishers, fire hose and safety equipment of **Fire-Fyter Co.,** Dayton, Ohio.

Eldon Irons Works, a new foundry for the production of soil pipe and fittings, has been established at Eldon, Iowa, by Lee Goodwin.

A. B. Johnson & Son, Belding, Mich., has announced plans for construction of a new iron foundry on a six-acre tract in Charlotte, Mich.

Hydropress, Inc., New York, has announced that the firm's Western representative, P. F. Bronckhurst, moved his office from Denver, Colo., to San Francisco before the opening of the Western Metals Show which was held at Oakland, Cal.

Palo Alto Foundry, 1695 Third St., Palo Alto, Calif., has been organized by E. G. Short and E. V. Fink, to manufacture aluminum and brass castings. The shop was formerly the **J. C. Mfg. Co.**

Facilities of **Central Foundry Division, General Motors Corp.,** will be expanded by the construction of a new malleable iron foundry at Danville, Ill., and a new gray iron foundry at Defiance, Ohio. The malleable plant will be constructed adjacent to the firm's present gray iron installation at Danville; and the Defiance foundry on a 265-acre tract acquired last fall.

Despatch Oven Co., Minneapolis, has appointed six new territorial sales representatives: in Indiana, John Wright, **Air Comfort Associates, Inc.,** Evansville, and G. W. McDaniel, 325 Bankers Trust Bldg., Indianapolis; for the Louisiana-Arkansas region, **Frederick & Baker,** 826 Ardis Bldg., Shreveport, La.; Pennsylvania-Delaware, W. T. Day, **Day Engineering Co.,** 300 Essex Ave., Narberth, Pa.; Georgia, South Carolina and Florida, DeWitt Gunsolus, 267 East Paces Ferry Road N.E., Atlanta, Ga., and, northern California, W. C. Matheson, 151 San Bruno Ave., San Francisco.

Operations have been started by **Grede Foundries, Inc.,** Milwaukee, at the firm's new modern gray iron foundry in Kingsford, Mich.

United Foundries Co. has opened a new plant, operating as United Casting Co., at Clarkston, Mich. Ready for immediate production of gray iron castings, the new foundry has 20,000 feet of floor space and is equipped with 16 squeezer and four jolt rollover machines.

Chapman's Foundry, Augusta, Ill., was recently issued corporation papers. Five new buildings have been added to the plant since 1945, when it was moved to Augusta from Plymouth following destruction of the original properties by fire.

Greg Iron Foundry, with 15,000 feet of plant space and three-acre grounds, has begun operation at 650 Hixon St., El Monte, Calif.

Navarac Foundry Co. has been organized at Boston, Mass., and is in production on bronze, copper, brass and aluminum castings for mills and factories in Worcester County. J. J. O'Malley is general manager in charge of operation and Joseph Zangarine is supervisor.

Fire caused an estimated quarter-million dollars damage recently to the **James W. Cloy & Sons Foundry,** Coshocton, Ohio.

The foundry division of **Mattison Machine Works,** Rockford, Ill., is again in gray iron castings production. A new building, rushed to completion to replace the original plant destroyed by fire last August, was recently completed. The new foundry incorporates latest developments in equipment for melting, sand mixing and core drying.

Dr. Vannevar Bush (center), recipient of the Hoover Medal for 1946, received the congratulations of Scott Turner, Greenwich, Conn., chairman of the Hoover Medal Board of Awards, following the presentation at the winter meeting of the American Institute of Electrical Engineers in the Engineering Societies Building, New York. E. L. Moreland (left), executive vice-president, Massachusetts Institute of Technology, Cambridge, delivered the presentation address on the occasion. Dr. Bush was selected as the ninth recipient, the citation read, "for outstanding public service as engineer, educator and administrator."

Mid-State Foundry Co. has been organized at Clio, Mich., and has purchased the foundry portion of the properties of M. Shelter & Sons, N. Railway St. N. M. Briskin and Joseph Jacobson, both of Detroit, are partners and will serve as, respectively, foundry and sales manager.

Racine Foundry & Mfg. Co. suffered destruction of nearly a third of its plant at 2301 Clay Ave., Hamtramck, Mich., in a fire April 8. The damage is expected to keep the brass and aluminum castings factory out of operation for two months.

Eutectic Welding Alloys Corp., 40 Worth St., New York, announces that R. D. Wasserman, president and head of the development and research laboratory, has been granted two patents on a metallic coating, know as "Eutectofilm." The film is now standard on most of the company's welding rods for torch applications.

National Supply Co. has announced plans for an addition to its foundry at Torrance, Calif., increasing floor space by 12,000 square feet over the present 90,000.

Westinghouse Electric Corp., Pittsburgh, recently announced the development of a new alloy, 64 Fe-35 Co-1 Cr, for use in generators and motors. Known as "Hiperco," the metal is said to be sufficiently tough to withstand intense vibration and to have a high magnetic saturation point. It is the product of 20 years of research, which only recently overcame the final difficulty, that of brittleness.

Nu-Way Oil Burner Corp., Rock Island, is constructing a 38 x 60 ft addition to its foundry.

Colson-Merriam Co., Baltimore, has been appointed exclusive Middle-Atlantic area distributor for the products of **Mealpack Corp. of America,** New York. States of Delaware, Georgia, Maryland, North and South Carolina, the District of Columbia, eastern Pennsylvania and southern New Jersey, are included in the territory. Colson-Merriam has regional offices in Philadelphia, Washington and Atlanta.

The foundry of **L. A. Darling & Co.,** at Coldwater, Mich., was destroyed by fire March 7, with estimated $250,000 loss.

American Brake Shoe Company has opened a new sales office at 1500 Walnut St., Philadelphia. Four divisions, National Bearing, Kellog, Brake Shoe & Castings and Electro-Alloys, will be represented.

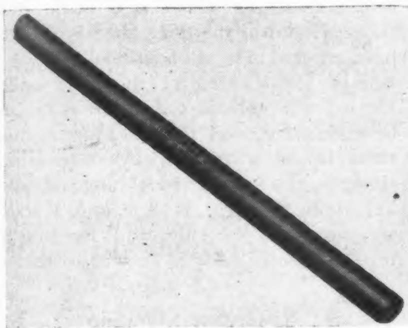
Paterson-Leitch Co., Cleveland, has completed a plant addition which will increase manufacturing space by 20 per cent. The steel fabricating firm this year observes completion of a third of a century of continuous operation under one management.

Substantial stock interest in **Dayton Oil Co.,** Dayton, Ohio, has been acquired by E. G. Allen, E. E. Hook and G. R. Sager, salesmen, and J. C. Eisman. All have been elected to the board of directors.

NEW PRODUCTS

Combustion Tubes

Harry W. Dietert Co., 9330 Roselawn Ave., Detroit 4, now offers "Zircotube," zirconium refractory base combustion tube for use in analysis of carbon and sulphur content. Available in a range of sizes, with either open or restricted ends, the tubes are said to withstand high temperatures, thermal shock and metal splatter, and to offer extra long life at high temperatures, as well as gas tightness and accuracy in size.



Free Machining Die Steel

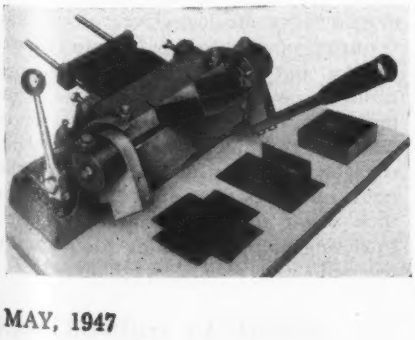
Vanadium-Alloys Steel Co., Latrobe, Pa., has developed a new steel for plastic molds and die casting dies for white metal alloys. Known as "Speed-Cut," the steel is said to be free-machining to an extent permitting hardening prior to finish machining. Hardenability is said to permit air hardening for hardness up to 300 Brinell, and higher values by oil quenching or "pack hardening."

Aluminum Brazing Flux

Air Reduction Sales Co., 60 East 42nd St., New York, announces "Elite Aluminum Brazing Flux," recommended by the firm as a high grade, yet economical flux with low melting point and designed for use with "Airco No. 26 Wire" in brazing 2S, 3S, 53S and 61S aluminum.

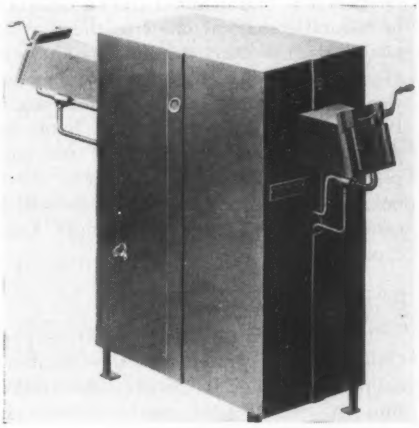
Forming Unit

O'Neil-Irwin Mfg. Co., Lake City, Minn., announces an improved model "Di-Acro Brake," precision unit for rapid forming of simple or complicated shapes in sheet steel, up to 16 gage, or other sheet materials. Designed for versatility and high production, the machine has found application in model shops, experimental laboratories and production departments.



Box Furnace

General Electric Co., Schenectady, N. Y., has designed a new box furnace to meet laboratories requirements for high, automatically controlled temperatures. Suitable for operation up to 3100°F, the unit can be used for melting and annealing, reduction of oxides, ceramic firing, and copper and silver alloy brazing. Since the heating elements must be protected against oxidation, operations are limited to those which can be performed in a protected atmosphere. Heating chamber, lined with refractory brick, is 4 in. wide, 4½ in. high, and 25 in. long. Top is removable for inspection and servicing.



Protective Helmet

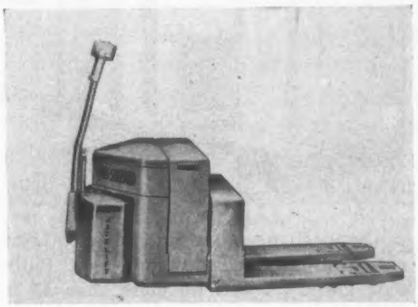
Mine Safety Appliances Co., Braddock, Thomas and Meade Sts., Pittsburgh 8, Pa., offers a new "Blastfoe" abrasive helmet designed to provide comfortable protection against high-velocity abrasives in shot or sand blasting operations. The unit provides compressed air under precise control of the wearer, with the supply line supported at the waist by a web belt. The headpiece is of aluminum, with the weight of the assembly distributed over the head through a cradle of strong webbing, and is covered by a loose-fitting hood of rubber impregnated cloth secured at the waist by adjustable straps.

Electric Furnace

Thermo Electric Mfg. Co., 480 Locust St., Dubuque, Iowa, offers for general laboratory use and for production heat treating of small parts, a new "Model CEA" electric furnace designed for fast heating—up to 1500°F in 30 minutes—and to hold any temperature from 500 to 2000°F automatically and continually. Body and door are cast of aluminum, and insulation is cast permanently in place within the body. Heating element surrounds the chamber to insure uniform heating, and may be easily removed for replacement. Available for use with either A.C. or D.C. current, at 115 or 230 volts.

Lift Truck

Lewis-Shepard Products, Inc., 248 Walnut St., Watertown 72, Mass., announces a new electrically-operated hand lift truck, available in both platform and pallet models. Every operation can be performed with the handle vertical. On release of the handle positive, quick-action electric brake stops the truck. Handle has a steering arc of 200°; wheels and gear drive, totally enclosed, are ball-bearing mounted, and the trucks are available in several lengths.

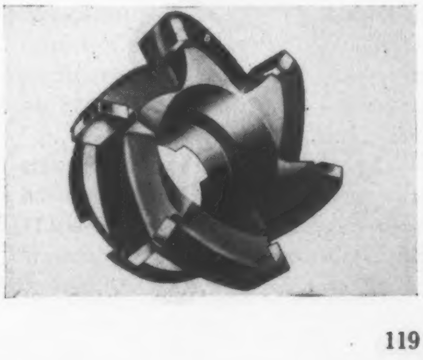


Live Centers

Holub Industries, Inc., Sycamore, Ill., introduces its new "Hi" live centers for elimination of friction in head and tailstock during high speed machining on lathes, grinders, milling machines, etc. The centers are equipped with preloaded bearings, and incorporate a heavy-duty "grease seal" to prevent entrance of foreign matter into the bearings. Another new product of the firm is a line of industrial flashlights, equipped with flexible metal tubing which can be bent at any angle and held in desired position. Designed for inspectors and maintenance men, the lights are available in small models employing penlight batteries and in standard-size models.

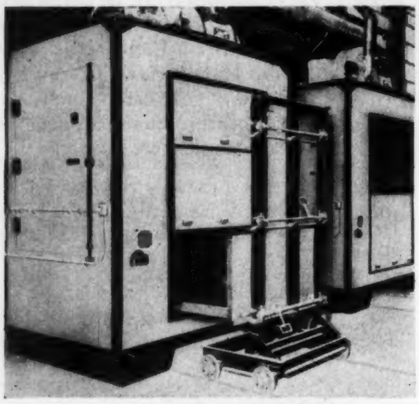
Shell End Mills

Vascoloy-Ramet Corp., North Chicago, Ill., recently introduced a new line of "Red Streak" carbide-tipped shell end mills, manufactured in right and left hand styles and various sizes. They are available with negative radial and axial rake angles for milling steel and with zero rakes for cast iron, non-ferrous metals and nonmetallic materials.



Pull-Drawer Oven

Gehnrich Oven Div., W. S. Rockwell Co., 200 Eliot St., Fairfield, Conn., offers a new type pull-drawer oven for such applications as core baking, mold drying, low temperature drawing and heat treating, and drying chemicals. Special feature is elimination of the superstructure usually required for support of steel overhead track on which drawers are suspended. In the new unit drawers are supported on a



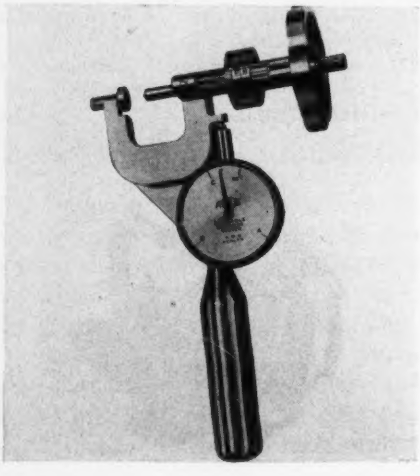
puller mechanism, set on a wheeled frame riding in guides on the plant floor. Puller base guide projects no more than 15 in. beyond front of oven at bottom. Electric, gas, oil or steam heat may be used, and an exhaust fan is installed on the roof.

Industrial Lamps

Lustra Corp. of America, 40 West 25th St., New York, announces a line of "Lustra Reflector Lamps" for industrial and commercial use. Construction features include solid silver reflector lining sealed inside the bulb, neck-reflector disks, precision-focused filaments; and the line includes wide-beam globes for such applications as overhead lighting in foundries, as well as tubulars, spotlights, etc.

Portable Hardness Tester

Ames Precision Machine Works, Waltham, Mass., is producing a new portable hardness tester, designed for rapid determination of hardnesses on rounds and flats up to one inch in thickness. Readings are on Rockwell A, B and C scales. Less than two pounds in weight, the unit has a handle grip, can be set, read quickly.



Departmental Trucks

Easy-Tote Products, Inc., Arcade, N. Y., offers a new line of hand trucks, designed to minimize manual labor in the moving of tote pans or other containers. They are also constructed to eliminate floor damage, wear on containers and to promote safety. Features include a crank and hook for pulling load onto truck; tilting, steel base plate, two inches from the floor; roller-bearing side wheels and a full-swivelling caster with anti-friction bearings. Load capacity is 600 pounds.

Pressure Gauge

W. C. Dillon & Co., 5410 W. Harrison St., Chicago 44, has announced a new mechanical pressure gauge for accurate determination of pressures or working loads in assemblies. The unit is designed for application with static or moving loads. A dial indicator is mounted to a V-shaped pressure bar. Loads applied to the bar, on anvils at its center, produce deformation which is measured by the indicator and translated into pounds pressure. The instrument can be adapted to measurement of tension on moving filaments, and outward thrust on moving shafts.

Ferrous Materials Analyzer

Allen B. Du Mont Laboratories, Inc., Passaic, N.J., has released in its latest refined form the "Ferrograph," an instrument designed to provide a simple and convenient method of comparing ferrous materials as to their chemical analysis and heat treatment. Composition and condition of ferro-magnetic materials are determined by magnetic testing, with the cathode tube as an instantaneous indicator, in this unit, based on the correlation between magnetic properties, particularly remanent magnetism, and metallurgical properties. Basic principle is harmonic analysis of induced voltage in the secondary of a test transformer in which the sample to be tested is made the core. Relatively unskilled personnel can operate the "Ferrograph," in which determination is made through visual comparison of amplitudes and phase angles. The unit is portable, completely self contained, weighs 115 pounds, and operates on 110-volt A.C. current.

Flexible Polishing Wheel

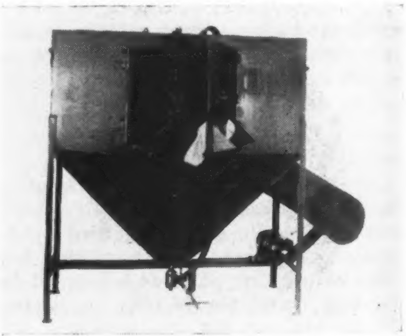
Manhattan Rubber Div., Raybestos-Manhattan, Inc., Passaic, N.J., offers the latest addition to its line of polishing and finishing wheels, a soft wheel bonded with a special modified compound of neoprene impregnated with abrasive grain. Supplied in the finer abrasive grain sizes or with pumice, rottenstone or other similar materials, the wheel is recommended for finishing stainless steel, glass, non-ferrous and precious metals. Because of the nature of the bond, speed must be limited to 3000 sfpm.

Slide Rule

Charles Bruning Co., 4754 Montrose Ave., Chicago, offers a new 10-in. slide rule, of plastic material that is said to have remarkable dimensional stability. Binding or sticking of the slide under varying atmospheric conditions is said to be eliminated, and the precision graduations to be unaffected by temperature changes. To permit wide range of service. A, B, CI, C, D, K, S, L and T scales are shown on the rule; and, for ease in reading, the CI scale is marked in red.

Sandblast Machine

Leiman Bros., Inc., 270 Christie St., Newark 5, N.J., features a combination door and work station, which can be swung easily aside to handle the work, in its new sandblast machine. The unit is self-feeding, the sand travelling from



the magazine into the blasting chamber, and returning by gravity to the magazine. Another feature is a removable, motor-driven basket, in which small parts are tumbled while under the sand spray and are exposed on all sides to the cleaning action. For larger parts, the total interior area may be used.

Door Closing Arms

Fleming Steel Co., New Castle, Pa., has developed a crane door-closing mechanism, featuring power arms and a series of mechanical and electrical interlocks, designed to insure positive, swift opening and closing. In a typical installation, the lower door slides completely aside to the right, engaging a combination interlock. The latter unlatches the upper door, which is then swung open by heavy duty cables. In closing, all operations are automatically reversed.

PATH OF PROGRESS

(Continued from Page 106)

"Melting of Brass and Bronze" proved to be a popular subject and the discussion leader, H. Smith, Federated Metals Div., American Smelting & Refining Co., Pittsburgh, Pa., was kept busy answering questions from the floor.

At the afternoon session, G. P. Halliwell of H. Kramer & Co., Chicago was the presiding officer and B. M. Loring, Naval Research Laboratory, Washington, Co-Chairman.

J. G. Kura and L. W. Eastwood of Battelle Memorial Institute, Columbus presented results of a study on *"Correlation of Structure and Properties 85-5-5-5 Alloy Test Bars,"* in which the three main structural features determining the tensile properties of the alloy were given as (1) the quantity and distribution of microporosity; (2) a decrease in pouring temperature, and (3) an increase in the solidification rate of the test section of the bar. Consequently, these factors tend to increase the tensile strength and elongation values.

Magnesium, commonly used by foundries in melting monel, is inadequate as a degasser in the indirect arc furnace, according to Bernard N. Ames and Noah A. Kahn of the Material Laboratory, New York Naval Shipyard. In a report on *"Gas Absorption Phenomena and Degasification of Cast Monel"* they said titanium, lithium and zirconium deoxidation yielded satisfactory results. Titanium will suppress hydrogen porosity in cast monel, it was stated.

SAND DIVISION

Technical Sessions of the Sand Division opened April 29, with E. C. Zirzow of the National Malleable & Steel Castings Co., Cleveland, presiding, and C. R. Wolf of the New Jersey Silica Sand Co., Millville, N. J. acting as Co-Chairman.

D. C. Williams of Cornell University, Ithaca, N. Y. was the first formal speaker, presenting results of recent investigations on *"Elevated Temperature Properties of Steel Foundry Sands."*

Because foundry sands must possess suitable grain size, refractoriness, bond, permeability and durability, a deposit of sand should be mapped and prospected in advance of development, declared F. P. Goettman of George F. Pettinos, Inc., Philadelphia. His topic was *"Preparation of Foundry Sands for Market."*

Reporting for the A.F.A. Subcommittee on Physical Properties of Iron Foundry Sands at Elevated Temperatures, H. W. Dietert of Harry W. Dietert Co., Detroit, presented results of tests made in the *"Evaluation of Core Knockout."*

In the case of a floor type foundry, increasing the metal section from $\frac{1}{4}$ to $\frac{1}{2}$ in. will cause a great reduction in core knockout time because for all practical purposes the $\frac{1}{2}$ in. metal section possesses twice as much heat as the $\frac{1}{4}$ in., he said.

"On an average, increasing the metal thickness from $\frac{1}{4}$ to $\frac{1}{2}$ in. reduced the time of core knockout to $\frac{1}{12}$ of the time in a floor type foundry," he added.

"In a system type foundry, one cannot expect the same degree of reduction for all types of cores as metal thickness of the casting is increased. A straight linseed-base oil bond type of core, for example, showed a reduction of $\frac{1}{5}$. When cereal binder and finer sand is present, increase in the metal wall caused a reduction greater than one-half. When the core contains pitch, or a combination of silica flour, western bentonite, cereal and oil base bond increased metal thickness does not materially reduce knockout time."

The second technical session of the Sand Division was held, April 30, with G. R. Gardner of the Aluminum Co. of America, Cleveland, as Chairman and K. J. Jacobson, Griffin Wheel Co., Co-Chairman.

In reviewing *"New Tentative Standards of Grading and Fineness of Sands,"* R. E. Morey of the Naval Research Laboratory, Washington, said accurate methods of measurement are becoming important.

Speaking of the *"Foundry Sand Laboratory,"* O. Jay Myers of The Werner G. Smith Co., Minneapolis, said that every foundry can derive benefits from a department of this type. The laboratory should experiment with sands, binders and mixing methods, he said.

Sand control has done much to reduce the number of castings made defective by improper handling of sand, declared Robert E. Morey and Carl G. Ackerlind of the U. S. Naval Research Laboratory, in a report entitled, *"A Study of the Precision of Sand Test Data."*

At the closing sand division session, H. F. Taylor of Massachusetts Institute of Technology, Cambridge, was Chairman and B. H. Booth of Carpenter Bros. Inc., Milwaukee, Co-Chairman.

In a report on *"Density of Molding Sand,"* H. W. Dietert, H. H. Fairfield, and E. J. Hasty of the Harry W. Dietert Co., Detroit, said foundry experiments indicate that the chilling effect of sand upon liquid metal is related to the density of the sand as rammed.

"Density of rammed sand is closely related to mold hardness," it was observed. "Grain size and distribution, clay and moisture content have an appreciable effect upon the den-

(Continued on Page 138)

Apprentice Contest

(Continued from Page 109)

Contest is traditionally carried out by a group of qualified men selected from the area in which the annual convention is held. Judges for the patternmaking division, working under the supervision of Frank Cech, Cleveland Trade School, Cleveland, who is chairman of the A.F.A. Industrial Training Committee, were: John Campbell, Cass Technical High School, Detroit; J. M. Duncan, Detroit Steel Casting Co., Detroit; Herman M. Reinhold, Ford Motor Co., Dearborn; Otto Yahnka, True Alloys Inc., Dearborn. Judging of the castings was directed by E. W. Pierie; the judges, all of Detroit, were: A. DiGiulio, consultant; H. A. Kelley, City Pattern, Foundry & Machine Co.; R. G. McElwee, Vanadium Corp.; W. B. McFerrin, Electro Metallurgical Co.; E. J. Rousseau, Commerce Pattern Foundry & Machine Co.; L. V. Savage, Detroit Steel Casting Co.; Harold Schroeder, Michigan Steel Casting Co.; E. E. Woodliff, Foundry Sand Service Engineering Co.

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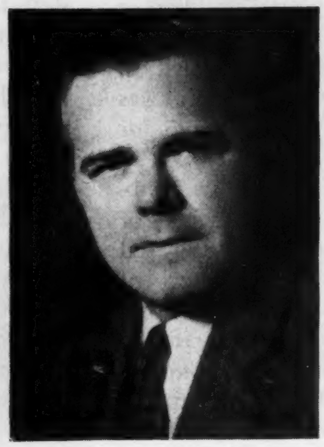
Cincinnati
Director
Central Indiana Chapter



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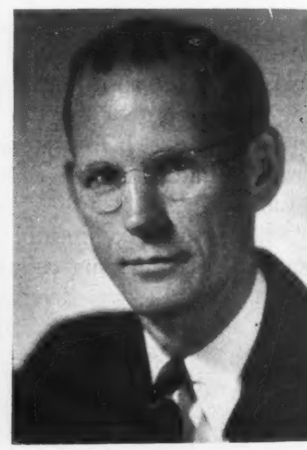

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Toledo Chapter

★ CHAPTER ACTIVITIES ★

news

Western Michigan

K. C. McCready
Muskegon Piston Ring Co.
Chapter Reporter

NATIONAL OFFICERS Night, in addition to a most instructive review of "The History and Development of the Foundry Industry," brought out a large attendance to the Western Michigan chapter's March 10 meeting at the Hotel Schuler, Grand Haven, Mich. National officers present were: A.F.A. National President S. V. Wood, president, Minneapolis Electric Steel Castings Co., Minneapolis; H. F. Scobie, A.F.A. Educational Assistant; A.F.A. National Director Bruce L. Simpson, president, National Engineering Co., Chicago, who also was the speaker of the evening, and A.F.A. Past President Ralph J. Teetor, Cadillac Malleable Iron Co., Cadillac, Mich.

W. A. Hallberg, Lakey Foundry & Machine Co., Muskegon, introduced the speaker of the evening, Mr. Simpson. With the help of numerous slides he covered the history of casting metals quite thoroughly. Large as well as intricate castings were made, which are yet surviving and are amazing, considering the knowledge, tools and equipment the old timers used.

Rudolph Flora, Clover Foundry Co., Muskegon, chairman of the chapter, presided at the meeting.

Central New York

J. A. Feola
Crouse-Hinds Co.
Chairman, Publicity Committee

NINETY MEMBERS and guests attended the April 11 meeting of the Central New York chapter held in the Onondaga Hotel, Syracuse.

A. L. Kress, a prominent industrial engineer and author, addressed the group on the subject "Human Relations in Industry."

Some of the fundamental principles that are necessary for good industrial relations as presented by Mr. Kress were: a good sound company policy understood by all who are in a supervisory capacity; recognition of employees as human individuals rather than clock numbers; personal contact with those under the supervisor's jurisdiction; a thorough knowledge of the operations controlled by a supervisor so that he may command the respect of those under him; recognition of a job that is well done; no favoritism; an explanation to each em-

Scene from the ASM Western Metals Congress which was held March 24-27, Oakland, Calif. Shown is the booth sponsored by the General Metals Corp., Los Angeles, where copies of the booklet THE FOUNDRY IS A GOOD PLACE TO WORK *were handed out by the Northern California chapter Educational Committee. As the Northern California chapter also had a booth at this show and distributed the above A.F.A. publication, Educational Committee Chairman and A.F.A. National Director S. D. Russell, Phoenix Iron Works, Oakland, and his committee had their hands full. Other Educational Committee members are Donald L. Mason, Stanford University, Palo Alto; Daniel Gallagher, Daniel Gallagher Draying & Foundry Supplies, San Francisco; Charles J. P. Hoehn, Enterprise Engine & Foundry Co., San Francisco; Ralph Hultgren, University of California and H. A. Bossi, H. C. Macaulay Foundry Co., both of Berkeley. Material was distributed through the courtesy William Butts, gen'l. manager, General Metals Corp.*

(Top)—A few of the Oregon chapter members who attended the March 21 meeting held in the Heathman Hotel, Portland. (Center)—E. J. McAffee, master patternmaker, Puget Sound Naval Shipyard, Bremerton, Wash., addressing the group. (Bottom)—Introducing the speaker, Mr. McAffee, to the membership is E. D. Boyle, master molder, Puget Sound Naval Yard.

ployee of his position on the production "team"; understanding of the employee's problems; and supervisors should not carry their personal feelings into the job.

Quad City

C. R. Marthens
Marthens Co.
Chapter Secretary-Treasurer

GUEST SPEAKER for the March 17 meeting of the Quad City chapter, held in the Fort Armstrong Hotel, Rock Island, Ill., was R. L. McIllvaine, vice-president and sales manager, National Engineering Co., Chicago. Covering "Foundry Mechanization," the speaker showed a number of slides illustrating modern mechanized foundries.

A movie was shown during the coffee hour of some of the major football games played during the 1946 season.

Northern California

C. R. Marshall
Chamberlain Co.
Chairman, Publicity Committee

MEETING AT the Hotel Alameda, Alameda, Calif., March 14, Northern California chapter members heard E. K. Smith, consulting metallurgist, Beverly Hills, Calif., present "Eighteen Kinds of Gray Iron from One Ladle." Mr. Smith's subject proved of real value to all and he stressed that gray iron, properly prepared, is a good product and one that fills many widespread requirements. His commentary was interspersed with accounts of his experiences as a government foundry technician in China as well as a number of excellent slides.

Oregon

A. J. Grbavac
Columbia Steel Casting Co.
Chairman, Publicity Committee

THE USE OF plastics for patterns was presented at the Oregon chapter meeting held March 21 at the Heathman Hotel, Portland. Dispenser of this information was E. J. McAfee, master patternmaker, Puget Sound Naval Shipyard, Bremerton, Wash.

The speaker reviewed that early in 1942, while searching the field of plastics for a suitable pattern material for foundry use, it was found that the thermo-setting phenolic casting resins were most adaptable. After a few patterns made of this material had been put in use by the foundry, this material was found to be adapted to foundry practice.

Presents Problems

However, the speaker stressed, the manufacture of this plastic presents many problems in order that good patterns may be produced in an economical manner, and without the use of valuable equipment.

Also included in Mr. McAfee's statements were disclosures of their findings to date; the quest for the best materials to use for molds and parting agents; and the proper casting methods to produce patterns of good quality.

Mr. McAfee was introduced by E. D. Boyle, master molder, Puget Sound Naval Shipyard.

February's meeting, held February 21 at the Heathman Hotel, Portland, opened with a motion picture showing the manufacture of grinding wheels at the Norton Co., Worcester, Mass. George Bogne, General Tool Co., Portland, gave a short talk following the movie.

Technical speaker was R. A. Quadt, research metallurgist, Federated Metals Div., American Smelting & Refining Co., Barber, N. J. Subject covered was "Aluminum Die and Permanent Mold Castings." He emphasized melting procedure; use of ladles and their linings; and types of furnaces used in the aluminum industry. He also explained the difference between atomic and

molecular hydrogen, and the latest methods of de-gassing aluminum metals.

Program Chairman O. J. Grant, Electric Steel Foundry Co., Portland, handled the introduction and discussion period.

Ontario

R. C. Tiplady
Westman Publications Ltd.
Chapter Reporter

THE ONTARIO chapter met at the Royal Connaught Hotel, Hamilton, on March 28. A sectional meeting was scheduled following dinner, at which time the membership would divide up into non-ferrous, malleable and gray iron groups.

The main feature of the evening was the announcement of election of officers and director for the coming chapter year, which are as follows: *Chairman,* J. Dalby, Wilson Brass & Aluminum Foundries, Toronto; *Vice-chairman,* R. A. Woods, Geo. F. Pettinos (Canada) Ltd., Hamilton; *Secretary-Treasurer,* G. L. White, Westman Publications Ltd., Toronto; and *Directors,* Neil Kennedy, Wm. Kennedy & Sons, Ltd., Owen Sound; R. T. Wilson, Ontario Malleable Iron Co., Ltd., Oshawa; and Reg. Williams, Canadian Westinghouse Co., Ltd., Hamilton.

Malleable Session

W. E. Kinread, Whiting Corp., Ltd., Toronto, in addressing the malleable section traced the history of continuous melting of malleable iron, pointing out that the following advantages of duplexing over batch melting could be classified under four groups:

(a) Fewer man-hours per ton of metal. This is important in these days of rising wages.

(b) Mechanization of the foundry allows specialization of labor. This makes for higher efficiency.

(c) Less floor space required per ton of metal.

(d) Better working conditions attract better personnel to the foundry.

The cupola to air furnace method of duplexing has gained in popularity over the cupola to electric furnace method because:

(a) Lower initial cost.

(b) Lower operating cost.

(c) Carbon can be reduced without cold steel additions.

(d) Grade 35018 can be produced if desired.

The speaker described the use of the unit type pulverizer in duplexing. Toward the end of the heat the carbon is held constant by adjusting the pulverizer to grind the coal coarser.

C. Williamson and N. Nesbitt of Grinnell Company of Canada then described their duplexing unit, and the many interesting experiences they had met within their practice.

The meeting then took the form of a round table discussion in which furnace bottoms, coal fineness, flame temperatures, refractory life, annealability of iron and many other pertinent questions were discussed.

G. C. Creusere of the Semet-Solvay Co., Detroit, in his address gave a very interesting account of foundry coke and its relation to cupola melting. In his opening remarks, Mr. Creusere said: "Before going into greater detail on the manufacturing phases of cupola coke, I would like to mention that we of the by-product coke industry have for a great many years been keenly conscious of the need and have experimented thru laboratory tests and considerable field work in an effort to find a method or formula by which the quality of foundry coke could be controlled and its performance predicted in operation.

Results of Study

However, thus far we must confess that our efforts have not been rewarded with the success hoped for and chiefly because of the following conditions: In the first place, there is a wide diversity of type of cupola operation and, as a consequence, a foundry coke which is ideal in performance in one plant will not necessarily give the same results in another. This is undoubtedly due to the fact that there

Photographs taken at the Oregon chapter meeting held in February at the Heathman Hotel, Portland. Technical speaker at this meeting was R. A. Quadt, Federated Metals Div., American Smelting & Refining Co., Barber, N. J. His subject was "Aluminum Die and Permanent Mold Castings."

are many variables in cupola operations of which coke is only one. Thus far it has been impossible to control or eliminate the variables.

"Furthermore, quality factors are not only important in themselves but in their inter-relations. The significance of this inter-relation has been difficult to measure because of different operating methods and other problems in the foundry.

"Finally, our industry has been severely handicapped in recent years by not being able to obtain the kinds of coal we want in the quantities needed for adequate foundry coke production.

"It is our confirmed opinion that the identification of quality characteristics and their inter-relation is a prerequisite to the adoption of useful standards for cupola operation. We coke producers are continuing our efforts toward the identification of these characteristics and the adoption of standards by which performance can be predicted, just as soon as the proper coals are available. Until more progress is made in this direction, however, we feel that our present policy of working closely with our customers as individual operating units and maintaining the most rigid controls possible in the manufacture of our products is the greatest contribution that can be made by the coke manufacturer to the gray iron foundry industry."

Erik Schleede of the United States Gypsum Company, Chicago, addressed the non-ferrous group on the subject of metal castings in gypsum molds.

Southern California

Maurice Beam
Los Angeles Times
Chapter Reporter

HOW TO MAKE a refractory material and how to keep it from going to pieces when in use is still the biggest problem of refractory makers, with car shortages, gas shutoffs and other disruptions next in order, said W. E. Daugherty at the April 4 meeting of the Southern California chapter at Los Angeles. Mr. Daugherty is manager, west coast refractory division, Laclede-Christy Co.; L. H. Butcher Co., Los Angeles representatives.

The most important refractory products being used in industry today, stated Mr. Daugherty, are silica-alumina, including fire clay, high alumina and sillimanite or kyanite. Others are acid refractories as represented by silica refractories; basic, as represented by magnesite; and natural as represented by chrome.

Purpose Specified

The speaker stressed that the day is past when fire brick can be ordered merely as so much brick. The purpose for which it is to be used must be specified. This was explained by a number of examples, such as, fire clays will stand temperature changes better than any others; silicas will carry high temperature loads and resist acid slags; chrome and magnesites are more refractory than fire clay and silica, but have low resistance to spalling and low load bearing capacity at high temperatures.

Supply Data

In closing, burning the brick was brought out and what refractory engineers hoped to accomplish by this practice. Mr. Daugherty urged foundrymen to supply refractory companies with data concerning service performance of their products. "Keep accurate records. Let us have them. It will help us and help you."

Quad City

C. R. Marthens
Marthens Co.
Chapter Secretary-Treasurer

THE TECHNICAL session of the April meeting, Quad City chapter, featured a talk by R. G. McElwee, Vanadium Corp. of America, De-

All the members and guests who attended the April 4 meeting, Southern California chapter seemed to be having a good time—so these photos reveal. (A)—Earl Anderson, Enterprise Iron Works, Los Angeles (left) and H. D. Coffman, Apex Steel Corp., Los Angeles. (B)—Left to right are W. F. Haggman, Foundry Specialties Co., Huntington Park; R. H. Hughes, Almquist Bros. & Viets Co., Los Angeles; and Bob Haley, Advance Aluminum & Brass Co., Los Angeles. (C)—Maurice Beam, Los Angeles Times and chapter reporter (left) harmonizing with George Wood, chapter photographer, as Miss Jules plays the accordion. (D)—Left to right at the speakers table Chapter President W. D. Emmett, Los Angeles Steel Casting Co., Los Angeles; Chapter Vice-President H. E. Russell, Eld Metal Co., Ltd., Los Angeles; Lt. E. C. Wiemer, guest speaker; and E. B. McDowd. (E)—W. D. Emmett (standing); O. H. Rosentreter, National Engineering Co., Los Angeles (sitting, left); and G. J. Nass, Brumley-Donaldson Co., Los Angeles. (F)—W. G. McLean, Snyder Foundry Supply Co., Los Angeles (left) and A.F.A. National Director George Dreher, Olds Alloys Co., Southgate. (G)—Myron Neisley, California Testing Laboratory, Los Angeles, limbers up his vocal cords as Miss Jules accompanies. Foreground H. E. Russell. (H)—At one of the tables (far side, left to right) J. C. Mullaney, American Manganese Steel Div., American Brake Shoe Co., Los Angeles; J. C. Meyer, Snyder Foundry Supply Co.; G. J. Nass; J. E. Folsom, Dealers Wholesale Co., Los Angeles; O. H. Rosentreter; J. R. Langston, Howell Foundry Co., Inc., Los Nietos; D. A. Eggleston, Kaiser Co., Inc., Bell; Geo. E. Sievert; and George Emmett, Los Angeles Steel Casting Co. (I)—Left to right J. C. Mullaney; W. G. McLean; E. C. Heyde, Apex Steel Corp.; and J. C. Meyer. (J)—Another view of dinner table shown in photograph H. (K)—Left to right J. K. Drake, Kennard & Drake, Vernon; D. C. Barnes and Frank Parker, Federated Metals Div., American Smelting & Refining Co., Los Angeles; V. P. Barton, Triplett & Barton, Inc., Burbank; and E. K. Smith, Beverly Hills. (L)—Left to right J. E. Hachteir, Atkins-Kroll Co., Los Angeles; C. R. McGraw, Long Beach Brass Foundry, Long Beach; W. E. Kreimeir, Dick Maynard and A. H. Lankford, Apex Steel Corp. (M)—Left to right Henry Riffe, G-B Brass & Aluminum Foundry Inc., Los Angeles; Bob Denton, G. Extale, M. H. Kunzman and Bob Hongola, General Electric Co., Ontario.


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troit. His subject was "Cupola Operation With Present Day Material Shortages." The speaker stressed the fact that gray iron foundries were all faced with the same problems, such as shortages of pig iron, coke and other items. However, he urged them to strive for higher yields.

Election Results

Annual election of officers and directors took place at this meeting and the following were elected to serve for next year: *Chairman,* R. H. Swartz, S & W Foundry Corp., Bettendorf, Iowa; *Vice-Chairman,* M. H. Liedtke, International Harvester Co., Rock Island, Ill.; *Secretary-Treasurer,* C. R. Marthens, Marthens Co., Moline, Ill.; *Directors,* W. C. Bell, Frank Foundries Corp., Moline; H. L. Mead, John Deere Harvester Works, East Moline; and H. A. Rasmussen, Ferro-Bronze Corp., Moline.

Following dinner, the more than 90 members and guests were entertained with music furnished by the "Rock Islanders" quartet.

Saginaw Valley

J. J. Clark
Chapter Reporter

POINTING OUT that during the war years low production costs were necessarily secondary to the major requirement of large quantities of castings in the minimum of time, J. L. Lucas, Meehanite Metal Corp., New Rochelle, N. Y., urged foundrymen to again scrutinize all operations and personnel to eliminate waste and thus lower costs. Addressing over 150 members and guests of the Saginaw Valley chapter April 3, Mr. Lucas' topic was "Waste in the Foundry Industry."

Lantern slides were used to assist the speaker in his examples of wasteful foundry practices in connection with labor, materials, planning of production and plant layouts.

Some of the causes of waste listed under labor were: poor planning of work to be done; molders doing work normally done by unskilled labor; poor housekeeping; excessive rest periods; lazy and indifferent employees; lack of any incentive plans for workers; and inadequate identification of equipment.

A few examples involved in materials waste were listed as: mixing of scrap materials for cupola; poor housekeeping; failure to analyze critical materials such as pig iron shipments and to pile them accordingly; failure to recover metal splash properly; use of excessive sprue and riser sizes; and overflowing iron in the molds.

Drawing upon some twenty years of experience in the foundry industry, the speaker was able to cite dozens of cases of waste and to show the savings resulting from correcting each practice.

In closing, Mr. Lucas recommended that plant management appoint a committee of two or three men to check through the plant for waste, and to record savings realized from improved practices. Personnel of the committee could be changed at intervals to obtain the benefit of new views.

Following the talk a sound-color film on "Alaska Adventures" was shown through the courtesy of Phil Rich, editor, *Midland Daily News.*

Central Ohio

D. E. Krause
Battelle Memorial Institute
Chapter Reporter

THE USE OF chemically coated sand for green sand molding aroused considerable interest at the March 24 meeting of the Central Ohio chapter. Although the subject for the meeting was announced as "Precision Casting," inability of the scheduled speaker to make the necessary transportation connections prevented him from appearing. However, Chapter Chairman N. J. Dunbeck, vice-president, Eastern Clay Products, Inc., Jackson, Ohio, gave a discourse on chemically coated sands.

MAY-JUNE CHAPTER MEETINGS

MAY 19
QUAD CITY
Fort Armstrong Hotel, Rock Island, Ill.
R. L. McIlvaine
National Engineering Co.
Foundry Mechanization
National Officers Night

MAY 20
TWIN CITY
Curtis Hotel, Minneapolis
T. E. Barlow
Battelle Memorial Institute
Cupola Hints and Pitfalls

MAY 26
Chittenden Hotel, Columbus
Pat Dwyer
Penton Publishing Co.
Heading and Gating

CENTRAL INDIANA
Athenaeum, Indianapolis
J. A. Gitzen
Delta Oil Products Co.
Corebinders and Corewashes

NORTHWESTERN PENNSYLVANIA
Moose Club, Erie
R. G. McElwee
Vanadium Corp. of America
Operating a Cupola under Material Difficulties

JUNE 2
CENTRAL ILLINOIS
Jefferson Hotel, Peoria
N. J. Dunbeck
Eastern Clay Products, Inc.
How to Select a Bond Clay

JUNE 7
SAGINAW VALLEY
Forest Lake Country Club
Summer Party

JUNE 13
SOUTHERN CALIFORNIA
Roger Young Auditorium
Past President and Old Timers Night
Installation of Officers

CENTRAL ILLINOIS
Second Annual Picnic

JUNE 21
DETROIT
Summer Outing

(*Photo courtesy Caterpillar Tractor Co.*)

V. A. Crosby, Climax Molybdenum Co., Detroit, showing one of his numerous slides to (right, seated) T. M. Logan, Caterpillar Tractor Co., Peoria, Vice-Chairman, ASM Peoria chapter; (left, standing) Zigmund Madacey, Caterpillar Tractor Co., Chairman, A.F.A. Central Illinois chapter; and (right, standing) F. W. Shipley, Caterpillar Tractor Co., Program Chairman, A.F.A. Central Illinois chapter, at the April 7 joint meeting of the A.F.A. Central Illinois chapter and ASM Peoria chapter.

Because of the speaker's familiarity with the subject, the talk aroused considerable interest. Although chemically coated sands are more expensive than the sands replaced, the increase in cost is more than offset by decreased cleaning costs and increased production it was related. The latter comes about through improved flowability of the sand, thereby decreasing molding time. Cost figures were given showing the advantages realized at the first commercial application at Lynchburg Foundry Co. Aside from increased ease of cleaning and production, defects due to sand are greatly reduced. The entire subject of chemically coated sands appeared to be the opening of a new era in green sand practice, which might well upset many preconceived notions of the behavior of molding sand.

Central Illinois

G. H. Rockwell
Caterpillar Tractor Co.
Chapter Secretary-Treasurer

A JOINT MEETING of the Peoria chapter, ASM, and A.F.A. Central Illinois chapter took place April 7 at the Jefferson Hotel, Peoria. The speaker was V. A. Crosby, Climax Molybdenum Co., Detroit. His topic for the evening's lecture was "Factors Affecting the Physical Properties of Gray Iron."

Mr. Crosby used slides to great advantage in illustrating the more important points of his presentation. The statistical graphs that he had prepared during his years of experience were helpful in following the gradual improvement in the structure of gray iron, principally through additions of alloys. It was brought out that in many cases where gray iron had failed as the proper material for a casting, its failure could be traced to improper design and relief of stresses.

Rochester

D. E. Webster
American Laundry Machinery Co.
Chapter Reporter

ROCHESTER CHAPTER had as its guest speaker at the April 8 meeting Pat Dwyer, engineering editor, *The Foundry*, Cleveland.

Speaking on the subject "The Foundry—Past and Present," Mr.

Central Ohio chapter officers and directors seated at the speakers table are in a jovial mood as they enjoy a break in their meeting program held March 24 at the Chittenden Hotel, Columbus.

(*Photo courtesy W. H. White, Jackson Iron & Steel Co.*)

Dwyer traced the growth and progress of this oldest of industries down through the years. Thousands of years back, working without equipment, facilities and controls (as we know them today), the ancients produced some outstanding examples of the metal founding art; in fact, some of their castings are considered masterpieces that have never been surpassed in quality, the speaker related. Some specimens of art bronze, dating back to ancient China, are to be seen in museums today, and their beauty and intricacy would tax the ability of modern metal founders.

A most successful and well-attended Seventh New England Foundry Conference was held at (above) Massachusetts Institute of Technology, Cambridge, March 28-29. This meeting was sponsored by the following societies: American Foundrymen's Association; Non-Ferrous Founders Society, Boston chapter; Connecticut Foundrymen's Association; and Connecticut Non-Ferrous Foundrymen's Association. Cooperating organizations included: American Institute of Mining and Metallurgical Engineers, American Society of Mechanical Engineers, American Society for Metals, American Welding Society and American Industrial Radium and X-ray Society. Conference Chairman was M. A. Hosmer, Hunt-Spiller Mfg. Corp., Boston.

Early Methods

In outlining the advance of the industry Mr. Dwyer informed the membership that the earliest metal forms were probably forged to shape from metal in a plastic condition. With the later development of crude furnaces for producing liquid metal a much broader field was opened up to artists and sculptors, and early castings were poured into crude molds formed of available local materials. The years that followed saw a gradual improvement in melting methods. The development of better melting equipment, more suitable fuels, and the consequent production of hotter and longer-lived metal permitted greater flexibility in casting production.

The invention of the cupola was a big step forward, the speaker reflected, and even today this melting unit continues to produce enormous tonnages of iron economically. Even though the cupola remains basically the same there have been many refinements in its design. The early introduction of bottom doors, improvement in refractory materials, better blower equipment, improved tuyeres, and blast control, all added to the wide application of this method of producing quality cast iron.

E. W. Ferm, Miller & Co., Chicago (center) greets two Swedish visitors C. G. Sporrong (left), foundry manager and Hans Rudberg (right), vice-president, The Iron Refining Co., Halleforsnas, Sweden. Mr. Sporrong and Ferm are cousins and had not seen or heard from one another in over 20 years. They met accidentally in a hotel lobby during the 51st A.F.A. Annual Convention.

Advance Great

Turning to present times, Mr. Dwyer emphasized that particularly within the past hundred years the industry has made great advances and kept abreast of modern requirements. The heavy demands of the railroad industry, and more recently the automotive and aircraft industries, have led to refinements in cast iron and steel production that were undreamed of a century ago. The development of the open-hearth furnace, the converter, and finally the electric furnace, and the knowledge of various heat treatments have all played a definite part in the advancement of this industry. And with all this technical knowledge there has been an equally rapid advancement in foundry equipment, handling and transportation.

In the general discussion period that followed his remarks Mr. Dwyer elaborated on recent foundry technological developments.

Birmingham District

AN EXCELLENT program brought out 120 local foundrymen to the April meeting of the Birmingham District chapter. They were first entertained by a color film on wild life "Hitting the Jack Pot in Alberta."

Following, there was presented a color film "Hot Strength Test of Molding Materials." A description was given of the method of forming test specimens in 1⅛ x 2 in. sand rammer for the hot strength test. Film also illustrated insertion of test specimen in furnace and loading sand in compression, penetration defect, method of increasing hot strength by reducing excessive addition of cereal binder, increasing hot strength by adding silica flour or fine sand for molding large castings, hot tear of steel casting due to excessive hot strength, testing hot strength of cores and methods on controlling the hot strength of molding sand and cores.

Film number two was on the "Study of Rat Tail Casting Defects" which was a detailed study of these

defects. Also illustrated were methods of testing sand at elevated temperatures and methods of stabilizing sands to withstand the thermal shock which they receive in a mold.

With the conclusion of the sand films, E. C. Finch, American Cast Iron Pipe Co., Birmingham, presented a number of very interesting films which were made in their plant showing some of the results of their work with the dilatometer. Especially interesting to the membership was the discussion on "sand properties at casting temperatures" as revealed by the dilatometer.

J. A. Bowers, American Cast Iron Pipe Co., presided over the technical session and the discussion period.

T. H. Benners, Jr., chapter chairman and T. H. Benners & Co., Birmingham, presided.

St. Louis District

J. W. Kelin
American Smelting & Refining Co.
Chapter Reporter

IN SPITE OF inclement weather 100 local foundrymen turned out for the St. Louis District chapter meeting held April 10. Featured on the evening's program was Frank Kiper, works manager, Ohio Steel Foundry Co., Springfield, Ohio, who discussed "Specification on Steel Castings." His talk, illustrated by slides, outlined details of specifications set up for steel castings, pointing out not only metallurgical problems but also the importance of physical properties. Proper emphasis was laid upon the importance of the right specification and the relationship of the specification to the final resulting steel casting.

The usual question and answer period followed.

Chapter Chairman Roland Leisk, American Steel Foundries, East St. Louis, Ill., then asked for the report of the Nominating Committee and the following men were elected officers and directors of the chapter for 1947-48: *Chairman,* N. L. Peukert, Carondelet Foundry Co., St. Louis; *Vice-Chairman,* A. L. Hunt, National Bearing Div., American Brake Shoe Co., St. Louis; *Secretary,* P. E. Retzlaff, Busch-Sulzer Bros.-Diesel Engine Co., St. Louis; *Treasurer,* H. W. Meyer, General Steel Castings Corp., Granite City, Ill.; *Directors,* Roland Leisk, R. E. Woods, M. W. Warren Coke Co., St. Louis; F. W. Burgdorfer, Missouri Pattern Works, Inc., St. Louis; and G. W. Shepherd, Duncan Foundry & Mach. Corp., Alton, Ill.

T. H. Ross, David Rankin, Jr. School of Mechanical Trades, St. Louis, Chairman of the chapter's Apprentice Training Committee, announced the winners of the local contest and presented them their prizes. The awards were given to Nick DiCarlo, Scullin Steel Co., St. Louis; O. J. Korte, Hoeflin Pattern Co.; M. G. Hecht, American Car & Foundry Co., St. Louis; Curtis Tucker, Fulton Iron Works Co., St. Louis; M. J. Foeller, Remmers Pattern Co., St. Louis; Eugene Kroeger, Scullin Steel Co.; Eugene Kaetzel, Central Pattern Co., St. Louis; and A. M. Sandweg, Missouri Pattern Works, Inc. Prior to the meeting, during the refreshment period, members of the chapter had an opportunity to view the patterns.

Some interesting remarks were given by Harry Brigget, a fellow foundryman from Australia, who is visiting U. S. steel foundries.

As an added feature, an archery demonstration of unusual interest was given by Fred Schmidt. Several chapter members were more or less unwilling partners in the act.

Northeastern Ohio

W. G. Gude
Penton Publishing Co.
Chairman, Publicity Committee

AN OVERFLOW attendance of 230 gathered for the April 10 meeting, Northwestern Ohio chapter at the Cleveland Club, Cleveland, to hear John Mescher, superintendent of core department, Unitcast Corp., Toledo, Ohio, discuss "Core Blowing." Chapter President Henry J. Trenkamp, Ohio Foundry Co.,

Top—Interest in the lecture course sponsored by the Saginaw Valley chapter is well illustrated here as members listen attentively to Don Bowman, Almont Mfg. Co., Imlay City, Mich., discuss "Molding and Coremaking." Bottom (left to right)—Frank Bean, General Foundry & Machine Co., Flint, Mich.; Don Bowman; Chapter Chairman John Smith, Chevrolet Grey Iron Foundry, Saginaw, Mich.; and Marshall Chamberlain, Dow Chemical Co.

Cleveland, presided at the meeting.

Mr. Mescher described the general practice of blowing cores, illustrating his remarks by slides and by a display of typical blown cores, coreboxes, blow plates and vents. He emphasized the importance of proper size and location of blow and vent holes. Ratio of size of vent holes to blow holes should be 2 to 1 in the case of slotted vents and 4 to 1 for the screen type, he stated. For most cores, sand moisture should be between 2.7 and 4 per cent.

Questions Asked

At the conclusion of his talk Mr. Mescher was aided in answering the numerous questions which developed, by Russell F. Lincoln, Russell F. Lincoln & Co., and Leon F. Miller, Osborn Mfg. Co., who served as discussion leaders.

Top—Interior of the new Lufkin Foundry & Machine Co., Lufkin, Texas, which was inspected by members of the Texas chapter recently. Bottom—Members present at National Officers Night held at Lufkin Country Club.

New England

M. A. Hosmer
Hunt-Spiller Mfg. Corp.
Association Reporter

THE ROLE OF gases in cast metals was the topic of a lecture at the April meeting, New England Foundrymen's Association, by Dr. Michael Dever, associate professor of Metallurgy, Massachusetts Institute of Technology, Cambridge. The lecturer outlined the general principles governing the solubility of gases in metals, and explained the effects of metal temperature, gas pressure and time of exposure on the absorption of gases. Differences between simple gases such as hydrogen and nitrogen and the compound gases, water vapor and carbon monoxide, were indicated.

Professor Dever suggested that hydrogen be considered as the most likely suspect if gas trouble occurs in ordinary castings. He emphasized the fact that metals may absorb hydrogen from water vapor. It was further stressed that the sources of water vapor are manifold and include rust on scrap, the products of combustion in open flame melting, condensed moisture and especially ladles that have not been dried sufficiently.

(Photos courtesy C. A. Wyatt, Debevoise-Anderson Co.)

Additional pictures taken at the New England Foundry Conference.

Metal Porosity

The lecturer discussed the various types of porosity found in light metals and the procedures for preventing gas unsoundness in them. It was shown that the behavior of gases in copper-base alloys, although somewhat complex, can be controlled. Finally, the role of gases in steel and cast iron was considered from the standpoint of the foundry metallurgist.

During the discussion period various related points were touched on such as the effect of gases on segregation. The great importance of mois-

ture as a potential source of gas unsoundness was further illustrated.

Philadelphia

H. V. Witherington
H. W. Butterworth & Sons Co.
Chapter Director

F. W. HANSON, metallurgist, Electro Metallurgical Co., New York, was the speaker at the Philadelphia chapter meeting held in the Engineers' Club, Philadelphia, April 11. The subject was "Conservation of Alloys in Steel Manufacture." Due to the fact that the iron foundry attendance greatly outnumbered steel, Mr. Hanson spoke on the same subject in relation to iron casting production. This was most interesting to the iron foundry representatives present, who at this time are having many difficulties due to the poor quality of scrap being used and the shortage of pig iron and coke.

Economical Production

Suggestions were also made in reference to the economical production of quality castings.

Chapter Chairman B. A. Miller, The Baldwin Locomotive Works, Cramp Brass & Iron Foundries Div., Philadelphia, announced the election of E. C. Troy, Dodge Steel Co., Philadelphia, *Chairman;* C. L. Lane, Florence Pipe Foundry & Machine Co., Florence, N. J., *Vice-Chairman;* and W. B. Coleman, W. B. Coleman & Co., Philadelphia, *Secretary-Treasurer.* These men will serve during the 1947-48 season as officers of the chapter.

Texas

NATIONAL OFFICERS Night, Annual Outing and Barbecue was celebrated by the Texas chapter April 11 at the Lufkin Country Club, Lufkin. S. V. Wood, A.F.A. National President and president, Minneapolis Electric Steel Castings Co., Minneapolis; W. W. Maloney, A.F.A. Secretary-Treasurer, Chicago; and A.F.A. National Director F. M. Wittlinger, Texas Electric Steel Casting Co., Houston, were among those present. David G. Anderson, National Founders Association, Chicago, also participated.

The meeting was under the chairmanship of Wm. M. Ferguson, Texas Electric Steel Casting Co. Technical speaker was C. H. Bone, Sheffield Steel Co., Houston, who spoke on "Coke Characteristics and Behavior."

A special luncheon was held in the afternoon at the Angelina Hotel, Lufkin, with W. C. Trout, Lufkin Foundry & Machine Co., Lufkin, acting as host. This meeting was held for visitors who were attending the annual meeting of the Texas chapter. Chairman was A. E. Cudlipp, Lufkin Foundry & Machine Co., and the speaker was Ed. C. Burrs, executive secretary, Texas Mfgrs. Association, Fort Worth.

Following the luncheon, a tour was made of the Lufkin Foundry & Machine Company's new plant and Texas Foundries, Inc. The Lufkin foundry boasts a new cupola, which has just recently been tapped in, a modern sand system, a cupola charging unit, larger shakeout, and also much larger and better pattern shop and pattern storage facilities.

April 10 the chapter held a Board meeting at the Houston Club, Houston, at which all Chapter Committee Chairmen attended.

Cincinnati

E. F. Kindinger
Williams & Co.
Chapter Secretary

ONE OF THE best meetings of the year was held by the Cincinnati District chapter April 14 at the Anthony Wayne Hotel, Hamilton, Ohio. A reason for this opinion was the straight-forward manner in which L. P. Robinson, Werner G. Smith Co., Cleveland, advanced his subject "What's New in the Core Room."

The 135 members and guests present heard Mr. Robinson state that often foundrymen are too close to the job to see exactly what is wrong; also that they sometimes are stubborn in their loyalty to old ideas that can be expensive and ineffi-

The Angelina Hotel, Lufkin, Texas, is the backdrop for this picture taken at the April 4 Texas chapter meeting. Top, left—At the speakers table seated (left to right) W. W. Maloney, A.F.A. Secretary-Treasurer, Chicago; F. G. Steinebach, Editor, The Foundry, Cleveland; D. G. Anderson, National Founders Association, Chicago; A.F.A. National President S. V. Wood, Minneapolis Electric Steel Castings Co., Minneapolis; A. E. Cudlipp, Lufkin Foundry & Machine Co., Lufkin; Ed. C. Burrs, Texas Manufacturers Association, Fort Worth; Wm. F. Ferguson, Texas Electric Steel Casting Co., Houston; and W. C. Trout, Lufkin Foundry & Machine Co., Lufkin. Top, right—S. V. Wood addresses the members at the evening meeting, held at Lufkin Country Club. Bottom, left—Wm. M. Ferguson comments on National Officers Night. Bottom, right—S. V. Wood, F. G. Steinebach, D. G. Anderson, Ex-Senator Martin Dies and W. W. Maloney, attired in 10-gallon hats, presented them as tokens of traditional Texas hospitality.

cient. Among other things discussed was the use of cereal binders, sand, baking time of cores, moisture, permeability and venting.

Chapter Chairman Joseph Schumacher, Hill & Griffith Co., Cincinnati, presided.

Texas

M. W. Williams
Hughes Tool Co.
Chairman, Program Committee

THE TEXAS CHAPTER held its regular meeting at the Beaumont Hotel, Beaumont, on March 21 and Nathan Janco, president, Centrifugal Casting Machine Co., Tulsa, Okla., spoke on "Centrifugal Castings."

Mr. Janco described the three methods of casting centrifugally, namely; true centrifugal, semi-centrifugal and centrifuging. He presented a number of castings which have been produced by centrifugal methods through the aid of slides. He also described the various types of molds which may be used in producing centrifugal castings and listed the advantages and disadvantages of each.

Most progress in the centrifugal field has been made in the casting of soil pipe and steel, the speaker pointed out, but some experimental work is now being done in the nonferrous alloys field, such as aluminum and magnesium.

The manufacture of bushings by the centrifugal method was explained and Mr. Janco said that contrary to the common belief of many foundrymen, it is now possible to cast centrifugally a 30 per cent lead alloy in certain sections under carefully controlled conditions.

A round table forum followed with various aspects of centrifugal casting being covered.

A sound film was shown at this meeting by Ampco Metals, Inc., Milwaukee, on "A Metal Without An Equal."

Tri-State

C. A. McNamara, Jr.
Big Four Foundry Co., Inc.
Chapter Secretary

THEME OF the April 18 meeting of the Tri-State chapter was "Treatment of Foundry Sands." The Mayo Hotel, Tulsa, Okla., was the scene of the regular chapter session at which Chapter Chairman R. W. Trimble, Bethlehem Supply Co., Tulsa, officiated. Speakers for the evening's program included E. J. AuBuchon, M. A. Bell Co., St. Louis, and C. A. Sanders, American Colloid Co., Chicago.

Stringing along with the adage "The show must go on," the Tri-State chapter carried on a successful chapter meeting recently although minus their guest speakers who were grounded due to inclement weather. However, the above chapter officers came to the rescue: (seated, left to right) Anton Johnson, Oklahoma Steel Castings Co., Tulsa; C. A. McNamara, Jr., Big Four Foundry Co., Tulsa; E. C. Graham, Acme Foundry & Machine Co., Backwell, and C. H. Bentley, The Webb Corp., Webb City, Mo.; and (standing, left to right) R. W. Trimble, Bethlehem Supply Co., Tulsa and B. P. Glover, M. A. Bell Co., St. Louis. Their program consisted of a movie and impromptu talks relating to shop equipment and discussion of current problems—molding or melting.

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CONVENTION

(Continued from Page 121)

sity of rammed sand. This density is modified by additions of commonly used foundry materials."

In a review of *"Physical Properties of Molding Sands,"* G. R. Gardner of the Aluminum Company of America, Cleveland, pointed to many factors which may cause moisture content of sand to change by the time it is finally rammed into the mold. Variations of the degree of ramming may be of considerable magnitude with the result that finished molds are likely to have properties different from laboratory test specimens.

Sand problems of Malleable, Non-Ferrous, Steel and Gray Iron foundries were freely and openly discussed during the 4-session sand shop course held on four consecutive days during the Convention, and the overflow attendance indicated that the practical men at the Convention were more than interested in sand control. Attendance this year was the greatest at any shop course held for a number of years.

Beginning the evening of April 28, the first sand shop course session covered *"Malleable Sand Problems"* at which D. F. Sawtelle, Malleable Iron Fittings Co., Branford, Conn., presided, and E. C. Zirzow, National Malleable & Steel Castings Co., Cleveland, acted as Co-Chairman. The discussion leader was David Tamor, American Chain and Cable Co., York, Pa.

Analysis of sand for clay content provided the central theme of early discussion at this informal meeting. This led to a general review of sand conditioning and the re-use of sand. It was the concensus of opinion that the presence of sludge, fines and excess clay were major causes of troubles. Big sand conditioning units were described as useful in improving the quality of reclaimed sand. Since malleable is a quicker hardening metal, factors relating to hardening in the mold must be watched closely, it was agreed.

The second Sand Shop Course session was called to order, the evening of April 29. The subject under discussion was *"Your Sand Pile,"*

(Continued on Page 140)

CONVENTION

(Continued from Page 138)

with W. M. Ball, Jr., of the Magnus Brass Div., National Lead Co., Cincinnati, serving as moderator. E. J. Bush of the Navy Yard, Washington, was Chairman for the session and E. W. Horlebein of Gibson & Kirk Co., Baltimore, Co-Chairman.

The subject coming before the closing Sand Shop Course meeting, the evening of April 30, was *"The Role of Sand in Hot Tearing,"* and J. B. Caine of the Sawbrook Steel Castings Co., Cincinnati, led the discussion. Attendance totaled approximately 125. Elements involved in the hard and soft ramming of molds were reviewed as were factors affecting hard and soft cores. Presiding at this session was R. H. Jacoby of the Key Co., St. Louis, while S. W. Brinson, Norfolk Navy Yard, Portsmouth, Va. was Co-Chairman.

The last of the sand shop course meetings on May 1 covered *"Variables in Gray Iron Sand Practice"* with an overflow crowd in spite of the late afternoon hour at which the session convened. C. B. Schofield, Chevrolet Grey Iron Foundry, General Motors Corp., Saginaw, Mich., handled the functions of discussion leader, and Co-Chairmen at the session were E. L. Thomas, Cadillac Motor Car Div. G.M.C., and F. R. Mason, Riley Stoker Corp., both of Detroit.

Educational Division

WITH THE CASTINGS industry conscious as never before of the need for an expanding interest in foundry activities, meetings of the A.F.A. Educational Division in Detroit were keyed on an optimistic note. F. C. Cech of the Cleveland Trade School, chairman at the opening session, April 28, presented the three speakers. B. D. Claffey of the General Aluminum & Gray Iron Foundry, Waukesha, was Co-Chairman.

Speaking on *"Management's View of Apprentice Training,"* Richard S. Falk of the Falk Corporation, Milwaukee, said that every war in which our nation has been involved called the apprentice away from his bench, and each time doubts arose as to whether appren-

(Continued on Page 145)

CONVENTION

(Continued from Page 140)

ticeship would regain its place.

"However," Falk observed, "apprenticeship is the cornerstone of industry's future planning, an investment by the young apprenctice in his future. Within the realm of absolute ability, it must not be altered or influenced by the day-to-day situation in our business."

A report, *"Foundry Training Course For College Graduates"* was submitted by A. W. Gregg, Whiting Corp., Harvey, Ill. as the representative of the A.F.A. Subcommittee on Training Graduate Engineers in Industry.

Pointing to the fact that industrial foundry training of college graduates is receiving increased attention, the report said more and more foundries recognize the contributions graduates can make.

College graduates look to the castings industry for a career because they are beginning to recognize the opportunities available and the absence of competition in this field, the report observed.

"Management's Stake in Training Foremen" was the title of an address given by S. G. Garry of the Caterpillar Tractor Co., Peoria, Ill.

"It is to the foreman that industry looks in seeking to control the costs upon which profit and the successful continuance of the enterprise depend," he said.

With A. W. Gregg of the Whiting Corp., Harvey, Ill. presiding and F. G. Sefing of the International Nickel Co., New York, serving as Co-Chairman the Educational Division held an evening meeting for general discussion of the many angles of *"Management's Stake in Personnel Training."* Dr. R. L. Lee of the General Motors Corp., Detroit, acted as discussion leader.

Closely akin to the Educational Sessions, although largely of an informal nature, was the Engineering School Graduates Luncheon on April 30, where a surprisingly large group entered into free discussion on problems of inducing the engineering school graduates to enter the foundry industry. Past-President F. J. Walls, International Nickel Co., Detroit, presided at the luncheon, assisted by G. K. Dreher, Olds Alloys Co., Southgate, Calif. This luncheon, for many years a traditional event, is gradually growing in popularity.

PATTERNMAKING COMMITTEE

USE OF SYNTHETIC plastic materials and cost factors were the principal points of discussion at the Pattern Division meeting in Detroit, April 29. V. J. Sedlon of the Master Pattern Co., Cleveland, acted as Chairman and A. F. Pfeiffer of the Allis-Chalmers Mfg. Co., Milwaukee. as Co-Chairman.

Because good pattern equipment can be a significant factor in the control and reduction of foundry costs, the purchase and making of this equipment should be carefully considered, W. G. Schuller of the Caterpillar Tractor Co., Peoria, Illinois, declared.

In his discussion of *"Pattern Purchase Considerations,"* Mr. Schuller described low first cost, generally, as poor economy. Maintenance costs may be high, casting quality may suffer and the production rate be low, he said.

(Continued on Page 146)

CONVENTION

(Continued from Page 145)

The purchase of patterns for another foundry requires a knowledge of that foundry's production facilities and techniques, Schuller said.

In a talk on *"Liquid Phenolic Casting Resins for Foundry Patterns,"* C. R. Simmons of Durez Plastics & Chemicals, Inc., North Tonawanda, N. Y., pointed out that synthetic plastic materials are finding increased application in the production of patterns and coreboxes.

The Patternmaking Division also sponsored a Round Table Luncheon May 1 at which H. K. Swanson, Swanson Pattern & Model Works, East Chicago, Ind. presided, assisted by Co-Chairman L. F. Tucker, City Pattern & Foundry Co., Inc., South Bend, Ind. Considerable interest was aroused over the subject of *"The Need for Close Relationship Among Patternmakers and Foundrymen."* A. F. Pfeiffer, Allis-Chalmers Mfg. Co., Milwaukee, acted as an able discussion leader.

REFRACTORIES COMMITTEE

THE ANNUAL TECHNICAL session of the A.F.A. Refractories Committee featured a "Question and Answer" panel with R. H. Stone, Vesuvius Crucible Co., Pittsburgh, as Chairman and A. S. Klopf, Western Foundry, Chicago, Co-Chairman.

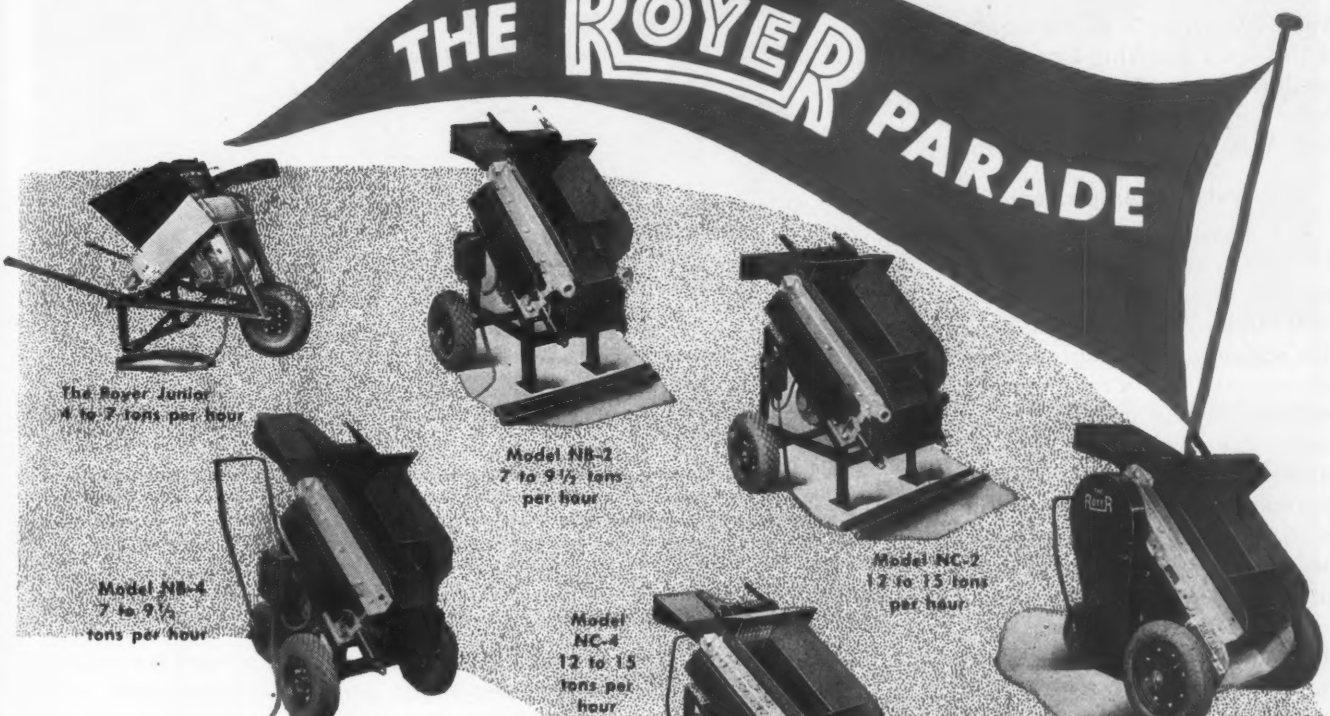
At the meeting, held April 29, William H. Henson of the Norton Company, Worcester, Mass., presented a paper on *"Special Refractories for Metal Melting."*

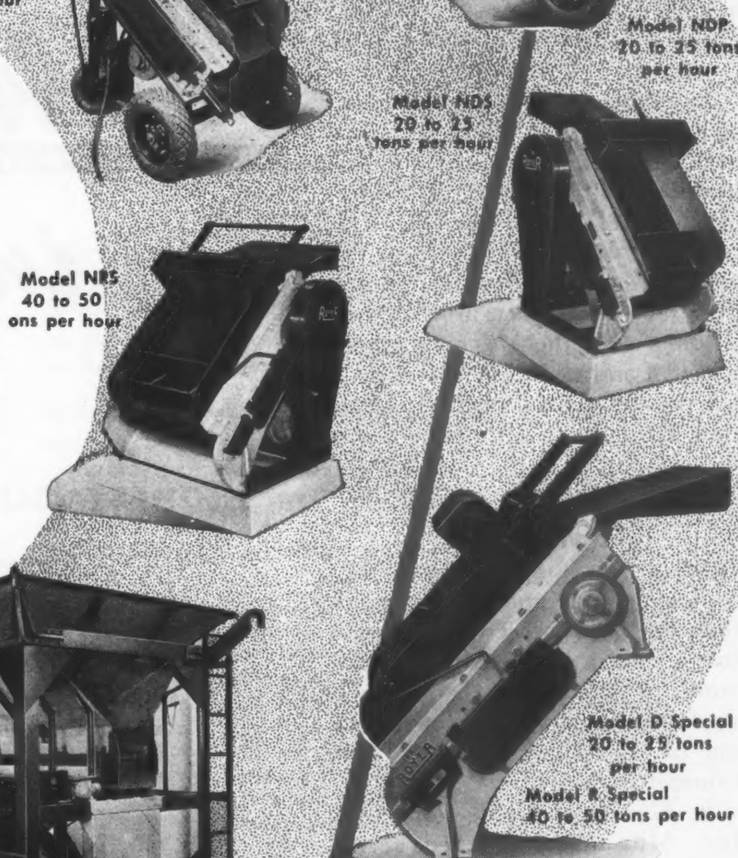
The term "special refractories" has been selected to designate those refractories whose basic raw materials have been synthetized or fused in electric furnace, he pointed out. This type of refractory cannot be recommended as a "cure all" for the foundryman's refractory problems, he added. Its use is limited to those instances where an economic advantage can be produced.

INSPECTION COMMITTEE

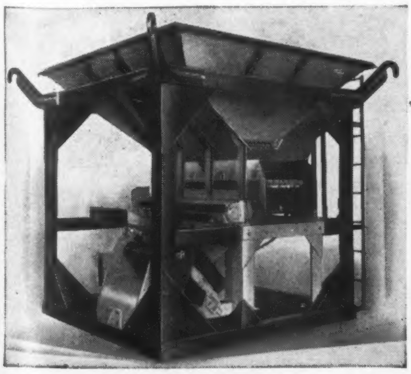
THE IMPORTANT A.F.A. Inspection of Castings Committee held a technical meeting the evening of

(Continued on Page 152)

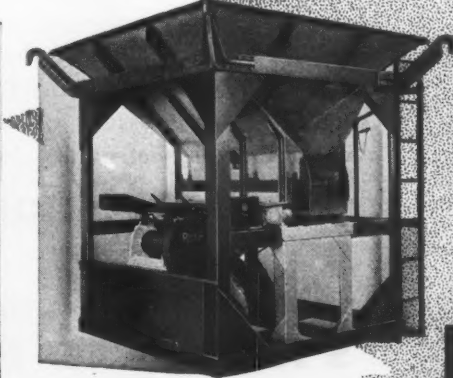




Royer Sand Separator and Blender installations reduce costs and discount losses for greater foundry profits—the Royer removes refuse, combs grain from grain, breaks up lumps and clay balls, blends new and old sand, distributes moisture evenly, increases permeability 10 to 20 points, double aerates. There's a model to meet every requirement for high-speed, low-cost production of ideally conditioned sand. Capacities available from 4 to 50 tons per hour in regular self-powered portable or stationary models. Special stationary models "D" and "R" produce from 20 to 50 tons per hour taking power from conveyor head or other available drive shaft. Models "NDC" and "RC" combine Royer Scrap Remover and Sand Separator and Blender to provide complete sand conditioning unit for large jobbing foundries. Send for bulletin 744.



Model RC Combination
40 to 50 tons per hour



Model NDC Combination
20 to 25 tons per hour

ROYER

FOREMOST IN SAND CONDITIONING EQUIPMENT

ROYER FOUNDRY & MACHINE CO.

KINGSTON, PENNSYLVANIA

CONVENTION

(*Continued from Page 146*)

April 29, with H. R. Youngkrantz of the Apex Smelting Co., Chicago, presiding, and H. C. Stone of the Belle City Malleable Iron Co., Racine, Wis., serving as Co-Chairman.

Value of Inspection

E. L. LaGrelius of American Steel Foundries, East Chicago, Ind., presented a report on the "*Importance of Radiography To Inspection*," at this session. Prominent among the advantages of x-ray inspection outlined by the speaker was rapid non-destructive examination of an entire lot of castings. With this method it also becomes possible to determine if defective castings have been properly repaired and to have an immediate check on uniformity.

The next speaker was W. E. Thomas of the Magnaflux Corporation, Chicago. In a report, "*Magnetic Particle Inspection in the Foundry*," he traced the value of that inspection in foundries in the economical production of better quality castings, including its utility in determining the proper number, location, and size of risers; determination of proper pouring temperatures, and its use in proper salvage and repair of defective castings. As an inspection tool, Mr. Thomas said the system is rapid, selective and non-destructive, making possible partial or total inspection in line with requirements.

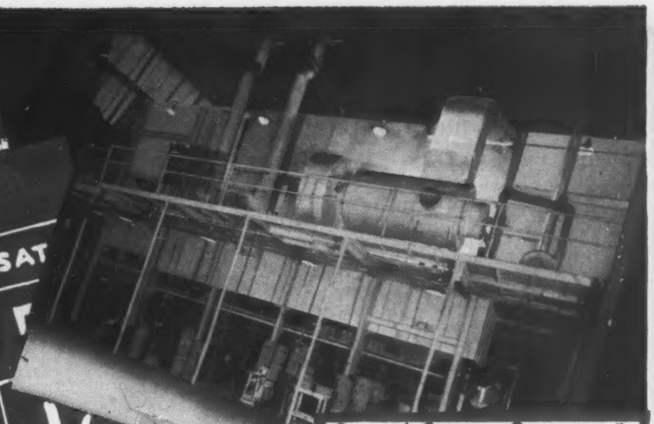
FOUNDRY COST COMMITTEE

ALL BUSINESS is, of necessity, cost conscious today and none more so than the foundry. Two experts on cost accounting stressed the importance of good bookkeeping and modern pricing methods at a meeting of the A.F.A. Foundry Cost Committee, May 1.

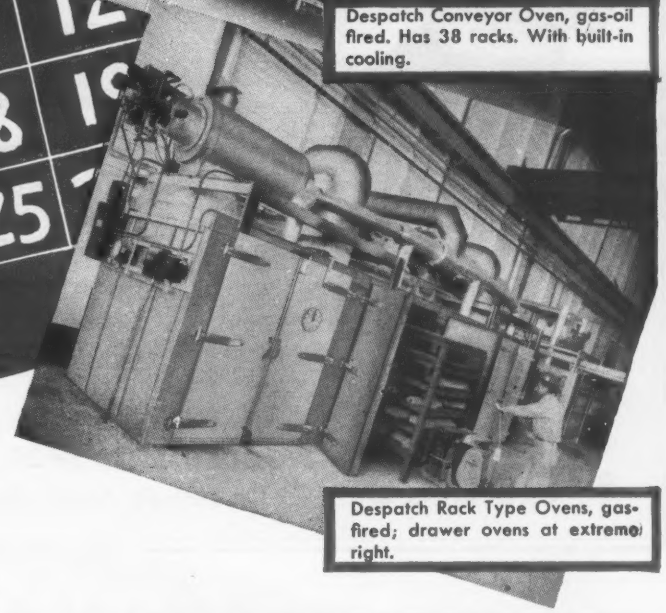
R. L. Lee of Grede Foundries, Inc., Milwaukee, presided at the session with G. E. Tisdale of the Zenith Foundry Co., Milwaukee, as Co-Chairman.

In a realistic and plainly stated analysis entitled "*Two Ways To Make a Profit*," Wally E. George of Booz, Allen & Hamilton, Chicago, said that some folks make money in

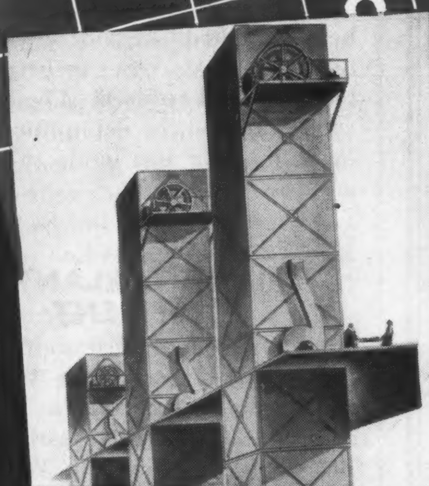
(*Continued on Page 154*)



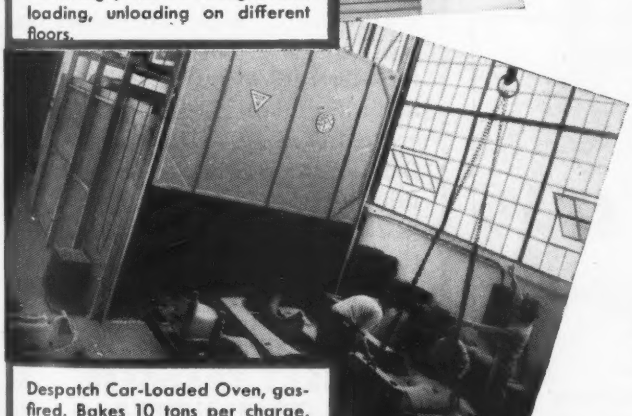
Despatch Conveyor Oven, gas-oil fired. Has 38 racks. With built-in cooling.



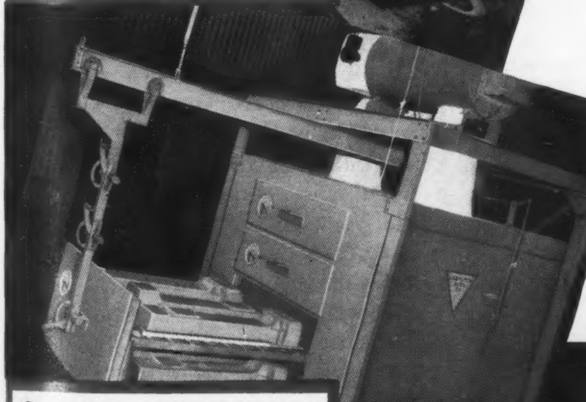
Despatch Rack Type Ovens, gas-fired; drawer ovens at extreme right.



Despatch Vertical Ovens; two are 74 ft. high, one 54 ft. high. Note loading, unloading on different floors.



Despatch Car-Loaded Oven, gas-fired. Bakes 10 tons per charge.



Despatch Drawer Oven for baking large and small cores at same time.

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CORE BAKING OVENS

For an oven that will stay modern year after year, you can't do better than choose DESPATCH. This is because every oven, batch or conveyorized, is *individually* engineered for the job it's got to do . . . with extra built-in capacity and flexibility to handle still tougher jobs tomorrow. In other words, your DESPATCH Oven "stays in style" . . . keeps on giving you *better*, faster, more economical performance.

Despatch Conveyor Ovens: Efficient labor-saving ovens that help cut core costs . . . give maximum output (over 10,000 lbs. per hour) from floor-space. Vertical, horizontal, elevated types; gas or oil.

Despatch Batch Ovens: Easy-loading high output ovens for all-purpose baking . . . can handle any job in your foundry. Available with double-end doors for extra-fast, straight line handling. Car, rack, truck and shelf models; gas, electric or oil.

Despatch Drawer Ovens: New, compact, fast-baking units for production or special jobs . . . bake thick and thin cores at same time! Very easy to load. In 48 popular models; gas, oil, electric.

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DESPATCH
OVEN COMPANY

CONVENTION

(Continued from Page 152)

the foundry business by the simple process of buying as cheaply as possible and selling at prices as high as the traffic will bear.

As described by C. E. Westover of Westover Engineers, Milwaukee, Wis., *"Foundry Costs and Cost Controls"* are always important, but assume even greater significance as the end of the non-competitive era of war production approaches.

"Cost accounting and cost control are both necessary and they should be coordinated," he said. "By means of cost control, costs can be predetermined and reduced. The break-even point can be determined and made to serve as a guide to profit and loss."

PLANT & PLANT EQUIPMENT

MECHANIZATION of foundries was the topic featured at the Wednesday session of the Plant and Plant Equipment Committee with E. W. Beach of the Campbell, Wyant & Cannon Foundry Co., Muskegon, Mich., in the role of Chairman.

Despite the many difficulties encountered in placing mechanized foundries in operation today, more and more plants are being so modernized, C. O. Bartlett of the C. O. Bartlett & Snow Co., Cleveland, told members of the group. He delivered the "theme" talk under the title *"Design and Operating Phases of Mechanized Foundries."*

HEAT TRANSFER COMMITTEE

THE REPORT OF THE A.F.A. Heat Transfer Committee was submitted at the morning session held on April 29 by the Chairman, H. A. Schwartz of the National Malleable and Steel Castings Co., Cleveland, Ohio, who presided as Chairman at the opening session of the group. E. C. Troy, Dodge Steel Co., Philadelphia, was Co-Chairman.

In concluding his report, Dr. Schwartz announced that the future committee work would include the study of heat conductivity of sands and mixed grain sizes, the completion of comparisons between the

heat flow analyzer work and the laboratory work on the freezing rate of cast iron and aluminum, and extension of work on solidification.

Dr. V. Paschkis, Columbia University, New York, presented a valuable summary of findings resulting from some investigational *"Studies on Solidification of Castings."*

H. Y. Hunsicker of the Aluminum Co. of America, Cleveland, appearing at the same session, reported an investigation of *"Solidification Rates of Aluminum in Dry Sand Molds."* This covered a major phase of the A.F.A. Heat Transfer Committee's attempt to correlate data obtained on metal solidification rates by experimental methods in the foundry with similar data determined by the less expensive electrical method.

Methods of *"Calculating the Size of Gates and Risers"* were outlined by Nathan Janco, of Centrifugal Casting Machine Co., Tulsa, Okla. To overcome the low yields resulting from the use of oversize risers, various methods of gating and risering castings have been introduced.

Freezing Rapid

H. F. Taylor of the Massachusetts Institute of Technology, Cambridge, presided at the evening Heat Transfer session, with W. J. Klayer, Aluminum Industries Inc., Cincinnati, acting as Co-Chairman.

Reporting on a study, *"Freezing Sand Molds,"* Dr. Schwartz told members attending the evening session that freezing progresses somewhat rapidly for the first three minutes or so. The rate of deposition of solid metal then slows up until about five minutes after pouring and then suddenly accelerates, the dendrites meeting in seven minutes.

C. F. Lucks, O. L. Linebrink, and K. L. Johnson of Battelle Memorial Institute, Columbus, reporting on *"Thermal Conductivities of Three Sands"* showed the rate at which conductivity increased with temperature.

In a report covering *"Influence of Properties on Solidification of Metals,"* presented by V. Paschkis of Columbia University, New York, the following conclusions were drawn: (a) The pouring temperature (superheat) has a marked influence on beginning and end of solidification; (b) The solidification range influences beginning and end of solidification an appreciable amount; (c) The specific heat is the determining factor as far as times for beginning of freeze are concerned but has less influence on times for end of freeze; (d) The heat of fusion has a relatively small influence on start of freeze and a large influence on end of freeze; (e) Of the three thermal properties, the conductivity has the smallest influence on solidification times; (f) The pouring temperatures are, of course, a question of production technique. It is important to determine accurately the specific heat and with reasonable accuracy the solidification range and heat of fusion. Conductivity may perhaps be accepted at estimated values without making a sacrifice in accuracy.

Under the title, *"Feeding of Metal Castings,"* A. F. Faber, Jr. of the

(Concluded on Page 157)

Time for a Spring Check-up . . .

on the plan that delivers Peace of Mind

THANKS to the work of patriotic volunteers, the U. S. Savings Bonds program has carried America a long way up the road to economic security.

During 1946, in spite of all the problems and uncertainties the nation faced, sales of Savings Bonds *exceeded redemptions* by $1,389,216,000. The success of this great sales operation has helped stem the tide of inflation, has reduced public debt holdings of the banking system, and has given millions of citizens a stake in their country and a profitable investment in their own futures.

Yes, we've come a long way—but the trip isn't over! Now is the time to check up on your Payroll Savings Plan. Make sure that all your new employees are familiar with its advantages. Remind *all* your employees that there's no easier, surer way to build their own futures—and America's—than by buying Bonds regularly through the Payroll Savings Plan. Every $3 invested pays $4 at maturity!

For any help you need in conducting the Payroll Plan, call on your State Director of the Treasury Department's Savings Bonds Division.

New Savings Bonds Plan won't affect the P.S.P.

SOON the Treasury Department and the banks of America will make it possible for farmers, doctors, and other self-employed people to participate in "automatic" Bond buying by special arrangement with their banks. This extension of the Savings Bonds program is not a partial payment plan and is intended *only* for people who are not in a position to take advantage of the Payroll Savings Plan.

The Treasury Department acknowledges with appreciation the publication of this message by

AMERICAN FOUNDRYMAN

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CONVENTION

(*Continued from Page 155*)

H. B. Salter Mfg. Co., Marysville, Ohio and D. T. Doll of the Case Institute of Technology, Cleveland, Ohio presented results of an investigation bearing on a more precise selection of dimensions for gates and feeders.

No rigid answer was given regarding the effect of the time required to fill a mold, or the possibility of an initial temperature differential, but the experimental technique used may help to provide the means whereby definite answers to these questions can be obtained, the group concluded.

JOB EVALUATION

The work of the Job Evaluation and Time Study Committee of A.F.A. was concentrated this year on the one subject of *"Establishment and Use of Standard Data"* and two sessions on May 1 were devoted exclusively to the topic. M. Annich, American Brake Shoe Co., Mahwah, N. J., presented the subject at both sessions and the capacity attendance vouched for the importance of the meetings. R. J. Fisher of The Falk Corporation, and J. A. Westover of Westover Engineers, both of Milwaukee, presided as Co-Chairmen at each session.

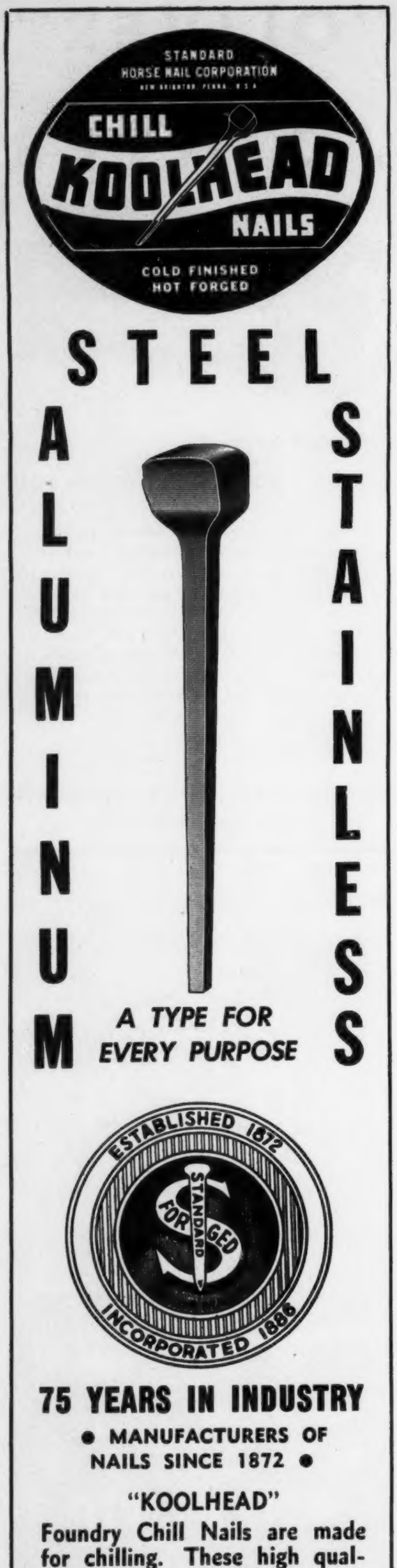
NEW ENGLAND

(*Continued from Page 107*)

mouth, Va., and outlined his treatise "Casting Defects and Remedies." Final paper was on "Gates and Risers for Sound Gray Iron Castings" prepared by H. C. Winte, Worthington Pump & Machinery Corp., Buffalo, N. Y.

Registration was under the chairmanship of C. A. Wyatt, Debevoise-Anderson Co., Boston, and Frank Kumer, Springfield Facing Co., acted as treasurer.

Much of the success of the conference can be attributed to the effort put forth by D. L. Parker; Howard Taylor; Frank Elliott, Westinghouse Electric Corp.; Leroy M. Sherwin; Henry Griggs, Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.; Dr. Walter M. Saunders; and D. F. Sawtelle.



Index to Advertisers

	PAGE
American Air Filter Co., Inc.	30
Apex Smelting Co.	28
Baroid Sales Div., National Lead Co.	152
Beardsley & Piper Co.	24–25
Bohn Aluminum & Brass Corp., Aluminum Refiners Div.	160
Bohn Aluminum & Brass Corp., Michigan Smelting & Refining Div.	22
Chain Belt Co.	23
Cleveland Flux Co.	143
Cleveland Quarries Co.	155
Delta Oil Products Co.	20
Despatch Oven Co.	153
Detroit Electric Furnace Div., Kuhlman Electric Co.	140
Dietert, Harry W., Co.	137
Dougherty Lumber Co.	146
Electro Metallurgical Co.	19
Electro Refractories & Alloys Corp.	144
Federated Metals Div., American Smelting & Refining Co.	141
General Electric X-Ray Corp.	6–7
Great Western Manufacturing Co.	139
Industrial Equipment Co.	27
Ingersoll-Rand Co.	18
International Nickel Co.	31
Jackson Iron & Steel Co.	157
Jeffrey Manufacturing Co.	21
Keokuk Electro-Metals Co.	11
Kramer, H., & Co.	1
Krause, Chas. A., Milling Co.	159
Logan Co.	29
McDougall-Butler Co.	145
Manhattan Rubber Div., Raybestos-Manhattan, Inc.	32
Mathieson Alkali Works, Inc.	2
National Engineering Co.	8–9
National Smelting Co.	135
Niagara Falls Smelting & Refining Div., Continental United States Industries Co., Inc.	138
Nichols Engineering & Research Corp.	148
North American Smelting Co.	149
Oliver Machinery Co.	157
Pangborn Corp., Metal Field Div.	15
Pennsylvania Chaplet Co.	148
Pennsylvania Foundry Supply & Sand Co.	136
Pittsburgh Crushed Steel Co.	142
Pittsburgh Lectromelt Furnace Corp.	Cover II
Pyrometer Instrument Co.	150
Reece Wooden Sole Shoe Co.	154
Royer Foundry & Machine Co.	151
Schneible, Claude B., Co.	16–17
Scientific Cast Products Corp.	157
Silent Hoist & Crane Co.	152
Simonds Abrasive Co.	147
Smith, Werner G., Co.	Cover III
Standard Horse Nail Corp.	158
Swan-Finch Oil Corp.	14
Tabor Mfg. Co.	26
Tonawanda Iron Corp.	13
Whitehead, Sanger & Hoidge	142
Whiting Corp.	Cover IV
Wilson, Lee, Engineering Co., Inc.	10